Appendix A

Multiple Parallel Approach Program Summary

Multiple Parallel Approach Program Simulations

Phase	Dates	Purpose	Approach	Runway Spacing	Display	Simulated Radar	Other	TWG Recommendation
I	5/16-6/10/88	DFW	Quadruple	5000 ft 5800 ft 8800 ft	SANDERS/DEDS	ASR-9 4.8s		Approved
II	9/25-10/5/89	DFW	Triple	5000 & 8800 ft	SANDERS/DEDS	ASR-9 4.8s		Approved
III	11/29-2/9/90	DFW	Dual and Quadruple	5000 & 5800 ft 8800 ft	SANDERS/DEDS	ASR-9 4.8s		Approved
IV.a	4/24-5/3/90	National Standards	Dual and Triple	4300 ft	ARTS III	ASR-9 4.8s		Not Approved
IV.b	9/17-9/28/90	National Standards	Triple	5000 ft	ARTS III	ASR-9 4.8s		Approved
V.a.1	5/15-5/24/91	National Standards	Dual and Triple	4300 ft	FMA	ASR-9 4.8s		Approved
V.a.2	9/24-10/4/91	National Standards	Triple	4000 ft	FMA	ASR-9 4.8s		Inconclusive
V.a.2.2	7/27-8/14/92	National Standards	Dual and Triple	4000 ft	FMA	ASR-9 4.8s		Inconclusive
V.b.1 & V.b.2	3/18-4/5/91	National Standards	Dual and Triple	3000 ft	FMA	E-Scan 1.0s		Not Approved
V.b.3	9/16-9/23/91	National Standards	Dual	3000 ft	FMA	E-Scan 1.0s	1-Degree Localizer Offset	No Decision Rendered See June '94
V.c	5/6/-5/14/91	National Standards	Triple	3400 ft	FMA	Mode S 2.4s		Inconclusive
V.d	3/2-3/13/92	Human Factors Study	Triple	3400 ft	FMA	E-Scan 1.0s	1 Mr Radar Accuracy	No Recommendation Made
n/a	9/8-9/25/92	High-Altitude Study	Triple and Quadruple	7600 ft 5280 ft 5348 ft	ARTS III	ASR-9 4.8s	Field Elevation 5431 ft	No Recommendation Made
n/a	11/16-11/20/92 11/30-12/17/92	DIA	Triple	7600 ft 5280 ft	FDADS FMA	ASR-9 4.8s	Field Elevation 5431 ft	Not Approved Approved
n/a	6/6-6/17/94	National Standards	Dual	3000 ft	FMA	E-Scan 1.0s	1-Degree Localizer Offset	Not Approved
n/a	7/11-7/22/94	National Standards	Dual	3000 ft	FMA	E-Scan 1.0s	2.5-Degree Localizer Offset	Not Approved
n/a	8/14-8/25/95	National Standards	Triple	4000 ft 5300 ft	FMA	E-Scan 1.0s		Not Approved
n/a	10/16-10/27/95	National Standards	Dual	3000 ft	FMA	E-Scan 1.0s	2.5-Degree Localizer Offset	Approved
n/a	4/15-4/26/96	National Standards	Triple	4000 ft 5300 ft	FMA	E-Scan 1.0s		Approved

Appendix B

Monte Carlo Simulation

B.1 Background

Researchers have increasingly performed real-time simulations of ATC operations in the evaluation of new ATC procedures and airport configurations. In real-time simulations, controller and aircrew/aircraft performance can be measured individually and combined in the system performance measures. One benefit of conducting real-time simulations with human operators is that unexpected effects of a procedure on system performance can be identified. A limitation of real-time simulations is that only a relatively small number of conditions can be tested economically. Thus, the data collected is usually a very small subset of all the possible conditions.

Because of the small subset of data collected in real-time simulations, there is a relatively large margin of error in the observed parameters. Confidence intervals are typically established to estimate the range of the simulation results. Since the sample sizes are rather small, the corresponding confidence intervals are rather large. If the real-time simulation results are used in the evaluation of a tested procedure, it is possible that a decision to accept or reject a procedure could be in error.

One way to refine and/or expand the results of a real-time simulation is to conduct a computer simulation, commonly called a Monte Carlo simulation. Researchers have used this technique successfully in the Multiple Parallel Approach Program (MPAP) and the PRM Demonstration Program to assess the probability of mid-air collisions during simultaneous parallel approach operations.

The Monte Carlo simulation uses the actual aircrew/aircraft and air traffic controller performance data collected in the real-time simulation and examines a large number of worst-case aircraft blunders. Typically the number of worst-case blunders is at least 100,000. This results in a very small confidence interval for the estimated TCV rate.

The Monte Carlo model used in the MPAP is a part of the Airspace Simulation and Analysis for TERPS (ASAT) System. This model was developed as an analysis tool for controller, aircrew/aircraft, and system performance, and is described in the following sections.

B.2 Airspace Simulation and Analysis for TERPS (ASAT) Model

The ASAT model is a new-generation Monte Carlo computer simulation system. Researchers developed it to perform complex multiple aircraft simulations in the study of obstacle clearance and airspace requirements for new standards, the re-evaluation of existing standards, and collision risk assessment during approaches, departures, missed approaches, and operations within the terminal area.

For the MPAP, researchers used the ASAT to estimate the probability of a TCV as a result of one aircraft turning unexpectedly from an ILS approach toward another aircraft on an adjacent

ILS approach. The blundering aircraft turned to a course 30 degrees from its approach course. The aircraft on the parallel approach, the evader, continued its ILS approach until contacted by ATC.

Figure B-1 shows the components and flow of the simulation for the ASAT. At a given time, several stochastic processes, including initial position of the aircraft relative to the other aircraft, system delay, controller response time, communication delay, and endangered pilot/aircraft response affected the distance between aircraft. The researchers declared values for each component at the beginning of each scenario. Simulation components, such as runway configuration and surveillance system performance standards, remained the same for all trials.

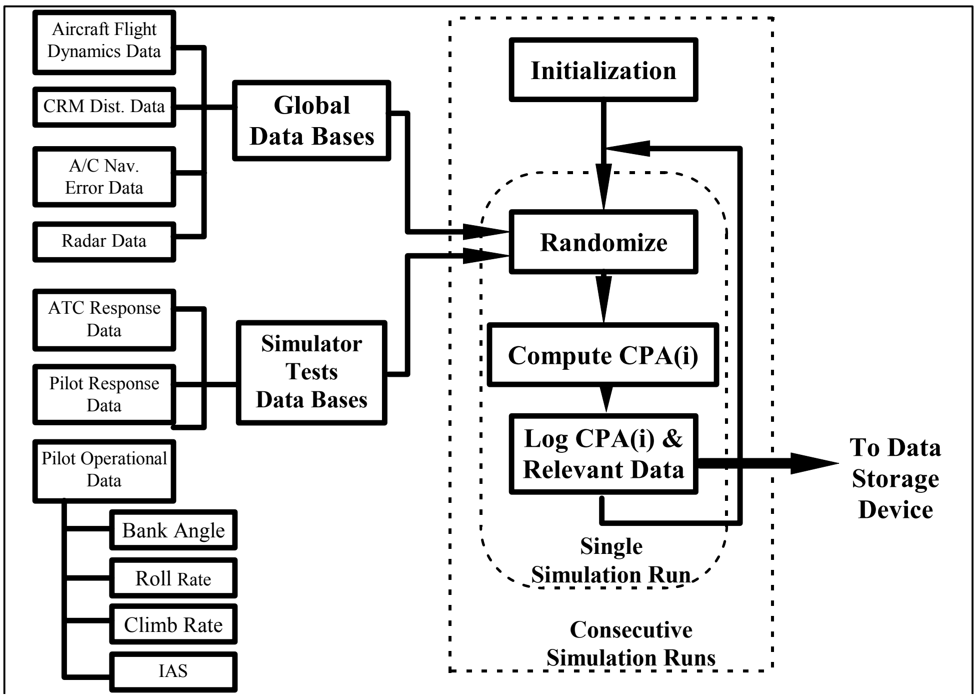


Figure B-1. Airspace Simulation and Analysis for TERPS (ASAT) Model.

The ASAT model determined the timing of the NTZ entry alert based upon the configuration of the blundering aircraft at the start of the blunder. The position of the aircraft relative to the NTZ, initial heading, speed, and random surveillance errors affected the timing. The model then analyzed the aircraft positions using the PRM alert logic. It generated an alert when the blundering aircraft was either inside the NTZ or projected to be inside the NTZ within 10 seconds.

During each trial, the blundering aircraft descended along the approach path until it reached the blunder start position. The approach course had a 3-degree glide slope and aircraft decreased speed in accordance with data collected in the real-time simulation. The blundering aircraft then turned toward the adjacent approach using a standard rate turn of 3 degrees per second. The aircraft continued turning until the blunder heading was reached. The blundering aircraft then continued at the final blunder heading until the end of the trial. The ASAT model executed blunders between 1.0 nm and 16.0 nm from the runway threshold.

Parameter assignments determined system delay, communication delay, and controller response time. System delay is defined herein as the interval between the start of aircraft interrogation to the time the detected or tracked target appears on the controller display. System delay was a constant based upon the PRM system specification. The researchers set it to 0.5 second for the ASAT. The communication delay was a random occurrence and as such was incorporated into the pilot response times generated in the real-time simulation.

The model updated the slant distance between blundering and endangered aircraft centers twenty times every second. The trial stopped when the closest point of approach (CPA) occurred. The model added the miss distance to the set of miss distances. If a TCV occurred, that model added that information to a file containing TCV data. The computer simulations then began the process again by selecting the positions and response variables for the next trial.

The ASAT model combined a high fidelity flight dynamics and FMS/autopilot model with atmospheric models for wind, temperature, and pressure. Aircraft manufacturers supplied flight data to develop the flight dynamics and FMS/autopilot models. The models were comparable in fidelity to the flight dynamics models used in certified motion-based flight simulators. The types of aircraft modeled using the ASAT included a B747, B727, and MD90. The atmospheric model was comparable to those used in certified motion-based flight simulators. The ASAT also modeled radar tracking systems and human performance.

B.3 Aircraft and Human Performance

The researchers extracted controller response times from data collected in the real-time simulation. The PRM provides two visual alerts and one aural alert whenever a blunder is detected. The first alert occurs when the PRM computer predicts that the blundering aircraft will penetrate the NTZ within 10 seconds. The first alert is called the yellow alert since the data tag of the aircraft turns yellow and an aural alert is issued. The second alert occurs when the blundering aircraft actually penetrates the NTZ. At that time the data tag of the aircraft turns red so the second alert is called the red alert. The researchers measured each response time as elapsed time from the start of the yellow alert until the controller of the evading aircraft began a message to the evading aircraft. They determined that there was no correlation of response time to distance from threshold. The researchers also found that there were no differences in controller response times due to aircraft type. However, they did find significant differences in controller response times due to runway spacing.

The researchers found that the mean controller response time for blunders occurring on the 4000 ft spaced pair was significantly larger than the mean controller response time for blunders occurring on the 5300 ft spaced pair. They even found that the mean controller response time for blunders occurring on the center localizer course was larger for those aircraft turning toward the 4000 ft spaced runway than the mean controller response time for those aircraft turning toward the 5300 ft spaced runway. These differences are probably the result of the method used for measuring controller response time. The yellow alert results when the aircraft is predicted to enter the NTZ within 10 seconds. When a blunder occurs on the 5300-ft pair of runways, the yellow alert requires more time to be activated than when the blunder occurs on the 4000-ft pair of runways. Therefore, the controllers had more time to observe the development of the blunder when it occurred on the 5300 ft pair and were prepared to key the microphone to transmit the breakout message to the aircraft when the yellow alert activated. If the researchers measured the response times from the start of the blunder, then perhaps there would not be a significant difference in controller response times. Statistics regarding the controller response times are presented in Table B-1. The response times for the center runway are divided into two groups, those that turned toward the runway spaced 5300 ft from the center runway, and those that turned toward the runway spaced 4000 ft from the center runway. The table indicates the direction of the blunder and the runway spacing, e.g., "18R to 18C 4K FT" indicates that the blunder started on runway 18R and moved toward 18C. The runway spacing for runways 18R and 18C is 4000 ft.

Table B-1. Controller Response Times in Seconds

	18R TO 18C 4K FT	18C TO 18R 4K FT	18C TO 18L 5.3K FT	18L TO 18C 5.3K FT
Mean	2.3	2.4	0.92	0.86
Standard Deviation	2.2	1.4	1.9	1.7
Maximum	8	5	9	5
Minimum	-1	-1	-2	-3
Count	19	58	51	22

Table B-1 clearly indicates that the average response time, when the blunder occurred on the 4000-ft spaced pair of runways, was significantly larger than the average time when the blunder occurred on the 5300-ft spaced pair of runways. The table indicates that the response time for the center runway depended on the direction of the blunder. If the blundering aircraft traveled toward runway 18R, the mean time was 2.4 seconds. If the blundering aircraft traveled from the center runway toward runway 18L, the mean time was 0.92 seconds. Therefore, controller response time, as measured in the real time simulation, depends on runway spacing. The table also indicates a close similarity of standard deviations. The researchers conducted statistical tests that verified that the mean controller response times were significantly different, but the standard deviations were not significantly different. Since the researchers found the controller response times to be dependent on runway spacing, they developed two probability distributions for use in the ASAT simulation, one for the 4000-ft runway pair and one for the 5300-ft runway pair.

The researchers determined pilot response times by measuring the time from the instant the controller pressed the microphone key until the start of the bank into the evasion turn. Since the time is measured from the controller key time, the pilot response time effectively includes the variation in the controller message time. The researchers found the pilot response times for the four aircraft simulators to be statistically similar so they pooled the times for all four aircraft simulators into one data set. In general, pitch-up into the climb started after the pilots initiated bank into the turn; however, in some cases the pilots started pitch-up first. The researchers measured the time difference between pitch-up and the start of the bank and found the time differences for all four aircraft simulators to be statistically similar. They pooled the time differences between pitch-up and the start of the bank into one data set. They configured the ASAT model to sample the pilot response times from the two distributions. Since the distribution of pitch-up times allows some negative numbers, the simulation occasionally permitted pitch-ups prior to the roll maneuver. If the selection of the two pilot response times led to a negative total time, the model discarded the times and took another sample. The model did not permit negative total pilot response times since the pilots could not anticipate controller breakout instructions. Table B-2 presents the basic statistics pertaining to these two distributions.

Table B-2. Pilot Response Time Distributions in Seconds

	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
Mike to Roll	7.0	3.1	2.7	17.8
Roll to Pitch-up	1.63	5.1	-7.6	22.4

The researchers extracted aircraft response characteristics from the real-time simulation data in order to produce evader flight tracks in the ASAT model. They grouped the empirical data according to similarities of the data. For example, they determined that the maximum bank angles for the AVIA and Oklahoma City B727s, and the Delta MD90 were similar, so they grouped the maximum bank angle data together to form one distribution. The maximum bank angles for the NASA B747 formed a separate distribution and were represented separately in the conduct of the ASAT model. Table B-3 summarizes the maximum bank angle statistics. The table indicates that on average the B747 pilots utilized smaller bank angles during the breakout maneuver than the pilots of the smaller aircraft. Table B-4 summarizes the roll rate statistics. The table indicates that on average the MD90 and B-747 pilots rolled their aircraft much slower than the pilots of the B-727 did.

Table B-3. Maximum Bank Angle Distributions in Degrees

SIMULATOR	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
AVIA,OKC,Delta	27.9	6.3	9.6	55.7
NASA	24.5	4.5	14.4	39.8

Table B-4. Roll Rates in Degrees per Second

SIMULATOR	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM	TYPE
AVIA	5.5	2.6	1.3	11.1	B-727
OKC	4.9	2.5	1.8	13.5	B-727
Delta	2.9	0.85	1.8	5.8	MD90
NASA	3.6	1.3	1.7	6.4	B-747

Table B-5 summarizes the maximum rate of climb statistics. Table B-6 summarizes the rate of rate of climb statistics. The rate of rate of climb is actually the acceleration into the climb, i.e., how rapidly the pilot pulled the aircraft into the climb.

Table B-5. Maximum Rates of Climb in Feet per Minute

SIMULATOR	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM	TYPE
AVIA	2301.4	761.4	12	4110.9	B-727
OKC	1922.2	744.4	526	3406.7	B-727
Delta	2742.4	995.3	1205.6	5044.6	MD90
NASA	2484.3	729.4	843.5	3630.9	B-747

Table B-6. Rate of Climb in Feet per Second

SIMULATOR	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM	TYPE
AVIA	147.7	98.8	14.5	407.8	B-727
OKC	232.1	106.5	31.9	422.4	B-727
Delta	94.6	60.2	32.7	315.5	MD90
NASA	195.9	69.2	31.9	334.8	B-747

For sampling purposes, the researchers fit continuous curves to each data set. They performed statistical tests to verify that curves were obtained that fit the data satisfactorily. The benefit of fitting continuous curves to the pilot and aircraft performance characteristics is that a complete spectrum of responses can be represented. If long gaps are present in the observed data, a continuous curve will ensure that during the Monte Carlo simulation no gaps will be present in the simulated data. The fitting process also provides, in the case of bounded data, estimates of the upper and lower bounds of the data. The researchers found the various performance distributions to be independent and modeled them as independent.

In the ASAT, the model positioned the aircraft so that the evading aircraft was at-risk. It accomplished this by first selecting a position for the blundering aircraft. It determined the position of the blundering aircraft laterally and vertically by random sampling from the probability distributions found in the ICAO Collision Risk Model (CRM). The longitudinal position of the blundering aircraft was set at a random distance from the threshold ranging from 1 nm to 16 nm. The real-time data distribution determined the distance distribution. Random sampling from the probability distributions found in the ICAO CRM determined the lateral and vertical positions of the evading aircraft. The model positioned the evading aircraft longitudinally by first positioning it somewhat closer to the threshold than the evading aircraft. Then the model ran so that the blundering aircraft performed the blunder maneuver, but the evading aircraft flew on course without an evasion maneuver.

As the blunderer passed the lateral position of the evader, the model stopped the simulation and used the miss distance to adjust the starting position of the blundering aircraft so that the evading aircraft would be at-risk. The model then reactivated and the evading aircraft performed an evasion maneuver. The model randomly selected the performance parameters of the evading aircraft from the distributions derived from the real-time simulation. This method can create an unlimited combination of aircraft tracks and aircraft pairings.

This method resulted in a very accurate determination of TCVs associated with at-risk blunder configurations. It was also comparable to the method used in the real-time simulation.

B.4 Configuration of the ASAT

For this study, the researchers configured the ASAT Monte Carlo simulation to match, as closely as possible, the real-time simulation. The ASAT configuration included the following:

a. Same runway and approach configuration,

b. Total Navigation System Error (TNSE) error distributions from the ICAO CRM,

c. Aircraft speed distributions derived from the real-time simulation,

d. Distributions of blunder starting points derived from the real-time simulation,

e. Same blunder configuration (30 degrees, non-responding),

f. Distributions of controller and endangered aircraft responses derived from the real-time simulation.

Although researchers use the distributions of aircraft, pilot, and controller responses derived from the real-time simulation to emulate the real-time simulation as closely as possible, they also employ other more realistic distributions in the ASAT simulation that are not possible in the real-time simulation. In the case of TNSE, the ASAT simulation used lateral and vertical error distributions about the glideslope that were not available in the real-time simulation. Researchers developed these distributions for the ICAO CRM and they are accepted internationally as accurate representations of Instrument Landing System TNSE. Thus, the ASAT system is able to more realistically model some aspects of the simulation than the real-time simulation.

Use of the ASAT system also permits the exploration of other sets of parameters that researchers did not consider in the real-time simulation. The variation of parameters and probability distributions is known as sensitivity analysis. In the real-time simulation, researchers selected the proportion of heavy jets, turbo jets, and general aviation aircraft prior to the simulation to emulate the expected traffic mix at Charlotte, NC in the year 2001. Because of the small number of blunders that can be simulated in the real-time simulation, they can only investigate one traffic mix. In the ASAT simulation, the researchers can easily change the traffic mix so that they can investigate the effect of increasing heavy jet traffic on the TCV rate. In the real-time simulation, the MPAP researchers observed large bank angles during the evasion maneuvers (see Table B-3). These large angles may be the result of the test conditions, i.e., since the pilots are flying simulators under test conditions they may be more willing to excessively bank the aircraft than they would during actual flight conditions. Since standard pilot procedures limit the aircraft to 30 degrees of bank, the ASAT simulation limited the maximum bank angle to values less than or equal to 30 degrees. Limiting the distributions in this way resulted in slower evasion maneuvers and thus a more conservative simulation.

B.5 Monte Carlo Output

The output of the ASAT was a distribution of CPAs for more than 100,000 trials. To estimate the TCV rate, researchers divided the number of CPAs less than 500 ft by the total number of at-risk blunders. They then used the TCV rate results in the analyses of the operational safety of the procedure.

Researchers can compare the estimates of the probability of a blunder occurring during actual simultaneous approach operations with the simulation results to determine the safety of the proposed operation. They combine the TCV rate with factors that estimate the probability of aircraft alignment (1/17), the probability the blundering aircraft does not respond (1/100), the probability of a blunder (1/2000), and the probability that a blunder will be 30 degrees (1/100).

Additionally, the MPAP researchers used the ASAT Monte Carlo simulation to conduct sensitivity analyses. They use sensitivity analyses to examine the procedure when limits are set on system performance. In this simulation, they investigated the effect of limiting the maximum bank angles of the evading aircraft to not more than 30 degrees. In addition, they investigated the effect of increasing the proportion of heavy jets.

B.6 Monte Carlo Results

The Monte Carlo simulation used distributions of controller response times, pilot response times, and aircraft performance parameters from the real-time simulation. However, it limited maximum bank angles to 30 degrees. The percentage of heavy aircraft ranged from 0 percent to 50 percent in increments of 10 percent. The researchers recorded the percentage of TCVs for each percentage of heavy aircraft. In addition, they computed upper confidence limits for a 99-percent level of confidence for each percentage of heavy aircraft. They computed TCV percentages and confidence limits for the 4000-ft spaced pair of runways and the 5300-ft pair of runways. They then combined the percentages to give an overall percentage of TCVs and confidence limits for each percentage of heavy aircraft. Table B-7 summarizes the results. In each case, the percentage of TCVs, both actual and upper confidence limits, are well below the allowable TCV percentages that the MPAP TWG established, and therefore meet the target level of safety established by the MPAP TWG.

Table B-7. TCV Rates by Percentage of Heavy Aircraft

HEAVIES %	4000 FT		5300 FT		COMBINED	
	ACTUAL %	UPPER LIMIT %	ACTUAL %	UPPER LIMIT %	ACTUAL %	UPPER LIMIT %
0	1	1.12	0.004	0.0186	0.502	0.562
10	1.208	1.34	0.004	0.0186	0.606	0.672
20	1.498	1.64	0.002	0.0149	0.75	0.823
30	1.796	1.95	0.002	0.0149	0.899	0.979
40	2.212	2.39	0.004	0.0186	1.108	1.196
50	2.32	2.5	0.002	0.0149	1.161	1.251

Appendix C

Risk Analysis

C.1 Overview

The TWG agreed to an analysis that relates the collision rate observed in the simulation to the test criterion of less than 1 fatal accident per 25 million approaches (4×10^{-8}). Analysis has shown that if the collision rate for triple approaches, given that an at-risk Worst-Case Blunder (WCB) has occurred, is less than 5.1 percent, and the collision rate for each adjacent runway pair is less than 6.8 percent, then the overall risk of a collision accident resulting from the triple simultaneous instrument approach procedure will be less than the test criterion.

MPAP simulations measure the Test Criterion Violation (TCV) rate, (i.e., the proportion of at-risk WCBs resulting in aircraft proximity of less than 500 ft). If one assumes that a TCV represents a collision, then the TCV rate observed in the simulation is an estimate of the risk of a collision on a simultaneous instrument approach, given that a WCB occurs and the aircraft are at-risk.

The real-time simulation TCV rate is an imprecise estimate of the collision risk resulting from a WCB since it represents only a small sample of blunders (usually 200 to 300 at-risk WCBs per simulation). With a small sample, it is possible for the measured TCV rate to exceed 5.1 percent, while the actual collision risk is less than 5.1 percent, and vice versa. This is because the sampling error is large, resulting in a large confidence interval for the true collision rate.

Therefore, MPAP researchers use a Monte Carlo simulation to increase the sample size and decrease the error in the measured TCV rate. The Monte Carlo simulation uses human and aircraft response data from the real-time simulation to generate altogether over 100,000 at-risk WCBs. The Monte Carlo sample sizes produce refined estimates of the collision risk. After validating the consistency of the Monte Carlo results with the real-time results, researchers use the Monte Carlo results to determine if the procedure has an acceptably low level of risk.

C.2 Risk Analysis

Several events must occur simultaneously for a collision to occur during simultaneous instrument approaches. Clearly, a blunder must occur or there would be no significant deviation from course. Previous testing has shown that blunders other than WCBs are of negligible risk, so the blunder must be a WCB. Also, the blundering aircraft must have a critical alignment with an aircraft on an adjacent course (i.e., it must be at-risk). If all of the above events develop, a TCV will occur if the controller and pilots cannot react in sufficient time to separate the blundering and the evading aircraft. In addition, one collision will involve two aircraft and will probably result in the destruction of both aircraft. Since the preponderance of accidents only involve one aircraft, for the purposes of this study, a TCV will be considered to produce two accidents.

Assuming that a TCV will result in a collision, the probability of a collision accident can be expressed in mathematical terms by:

(1) P(Accident) = P(TCV and At-risk and WCB and Blunder) x 2

or

(2) P(Accident) = P(TCV|At-risk and WCB and Blunder) x

P(At-risk|WCB and Blunder) x

P(WCB|Blunder) x

P(Blunder) x 2

Where:

<u>P(TCV and At-risk and WCB and Blunder)</u> is the probability of all relevant events occurring simultaneously (i.e., an at-risk WCB that results in a TCV).

<u>P(TCV|At-risk and WCB and Blunder)</u> is the probability that a TCV occurs given that an at-risk WCB has occurred. The simulation of at-risk WCBs in the real-time and Monte Carlo simulations (i.e., the TCV rate in the simulation) results in an estimate of this quantity.

<u>P(At-risk|WCB and Blunder)</u> is the probability that a WCB has critical alignment with an aircraft on an adjacent approach. Analysis conducted in preparation for this simulation indicates that a value of 1/17 is a good approximation of this quantity, given 3 nm in-trail spacing.

<u>P(WCB|Blunder)</u> is the probability that a blunder is a WCB. This probability is unknown, but researchers estimate it to be approximately 1/100 (PRM Demonstration Report, 1991).

<u>P(Blunder)</u> is the probability that a blunder occurs during a simultaneous instrument approach. This rate is also unknown, but researchers estimate it to be no more than 1 30-degree blunder per 1000 dual approach pairs or 1 30-degree blunder per 2000 approaches. This is a conservative value the MPAP researchers derived from the risk analysis conducted during the PRM Demonstration Program. Until they can derive a blunder rate estimate from field data of actual blunder occurrences or other evidence suggests using a different value, the TWG has agreed to use 1/1000 30-degree blunders per dual approach pair. Researchers can show the rate for triple approaches to be 1/1500 30-degree blunders per triple approach trio.

<u>The factor of 2</u> represents two accidents per collision.

C.3 Target Level of Safety

MPAP researchers extracted the total number of air carrier accidents as well as the number of fatal accidents on final approach from NTSB data for the time period, 1983-1989. This number, together with the total number of ILS approaches flown during this time period, leads to an estimated fatal accident rate during ILS operations performed during IMC of 4×10^{-7} fatal accidents (ACC) per approach (APP). There are a number of causes of accidents during final approach, such as structural failure, engine failure, or midair collision. An initial estimate is that there are nine possible causes of accidents on final approach. The implementation of simultaneous parallel approaches creates a tenth possible accident cause, a collision with an aircraft on an adjacent approach.

For simplicity of model development, the researchers assume that the risks of the ten potential accident causes are equal. Thus the contribution of any one of the accident causes would be one-tenth of the total accident rate. Based on this, the target safety level for midair collisions on simultaneous parallel approaches is 4×10^{-8}, or:

$$\frac{1 \text{ ACC}}{25 \text{ mill APP}}$$

C.4 Maximum Allowable Test Criterion Violation Rate

Since the only undefined variable in equation (2) used to compute the maximum acceptable accident rate is the TCV rate, it is possible to determine the maximum allowable TCV rate which would meet the target level of safety. Knowledge of this number would allow the TWG to quickly decide if the simulated operation would meet the target level of safety. One can determine the maximum allowable TCV rate for triple approaches from the following analysis.

Given the target level of safety, P(Accident) = 4×10^{-8}, then equation (2) becomes:

P(TCV|At-risk and WCB and Blunder) $\times$ P(At-risk|WCB and Blunder) $\times$ P(WCB|Blunder) $\times$ P(Blunder) $\times$ 2 = 4×10^{-8}

or,

(3) $$P(TCV|At-risk\ and\ WCB\ and\ Blunder) = \frac{4\times 10^{-8}}{1} \times \frac{1}{P(At-risk|WCBandBlunder)} \times \frac{1}{P(WCB|Blunder)} \times \frac{1}{P(Blunder)} \times \frac{1}{2}$$

Substituting values from (2) into (3) yields:

(4) $$P(TCV|At-risk\ and\ WCB\ and\ Blunder) = \frac{4\times 10^{-8}}{1} \times \frac{17}{1} \times \frac{100}{1} \times \frac{1500}{1} \times \frac{1}{2} = 5.1\%$$

Thus, if the simulation results support the assertion that the probability of a TCV, given that an at-risk WCB occurs (P (TCV|At-risk and WCB and Blunder)), is less than 5.1 percent, then the simulated simultaneous approach procedure should have an acceptable accident rate. In a similar fashion, the maximum allowable TCV rate for dual approaches is 6.8 percent.

Researchers must be careful when determining whether a given triple approach operation meets the target level of safety. It is possible for the TCV rate for the triple approach to be less than 5.1 percent while the rate for one of the adjacent runway pairs exceeds 6.8 percent. In this case, the adjacent runway pair would not meet the target level of safety. The MPAP TWG determined that the target level of safety should be met for the triple approach operation and for each adjacent runway pair when considered as a dual operation. Therefore, the aggregate TCV rate for the triple approach operation must not exceed 5.1 percent and the TCV rate for each adjacent runway pair must not exceed 6.8 percent.

The TCV rate derived directly from the real-time simulation is subject to variation due to the small sample of at-risk, worst-case blunders obtained from the simulation. To compensate for this variation, MPAP researchers compute 99-percent confidence intervals of the TCV rates from the observed TCV rate and sample size. If the largest value of the confidence interval, called the upper confidence limit, is less than 5.1 percent for the triple approach, then it is very likely (the probability is 0.995) that the actual TCV rate is less than 5.1 percent. In addition, if the upper confidence limit of each of the confidence intervals for the adjacent runway pairs is less than 6.8 percent, then it is very likely that the actual TCV rate is less than 6.8 percent for each adjacent runway pair. If the upper confidence limit of the triple approach is less than 5.1 percent and each of the upper confidence limits of the adjacent runway pairs are less than 6.8 percent, then the simulated procedure may be considered to have an acceptable risk of collision. However, given the small sample size, it is possible for the confidence interval to extend above 5.1 percent even though the observed TCV rate is less than 5.1 percent. In a similar fashion, the upper confidence limit computed for a dual approach could be larger than 6.8 percent even though the observed rate is below 6.8 percent. If an upper confidence limit for the triple approach or one of the dual approaches exceeds the acceptable TCV while the observed rate is below the acceptable rate, then the real-time simulation is said to be inconclusive. If the real-time simulation is inconclusive, then researchers can use the Monte Carlo simulation to obtain a more accurate estimate of the TCV rates.

Researchers use the Monte Carlo simulation to effectively increase the sample size of worst-case blunders to over 100,000, based on data derived from the real-time simulation, to provide another estimate of the TCV rates. Since the sample size is very large, the 99-percent confidence intervals obtained from the Monte Carlo simulation will be much smaller than the confidence intervals obtained from the real-time simulation. The TCV rates of the Monte Carlo simulation are considered to be statistically consistent with the TCV rates of the real-time simulation if the TCV rate confidence intervals of the Monte Carlo simulation intersect or overlap the confidence intervals of the real-time simulation. If the TCV rates observed in the real-time simulation and the Monte Carlo simulation are statistically consistent and if the largest value or upper limit of the aggregate Monte Carlo simulation confidence interval is less than 5.1 percent and each of the upper limits for the adjacent runway pairs is less than 6.8 percent, then the MPAP researchers consider the simulated procedure to have an acceptable risk of collision.

C.6 Summary Of The Risk Evaluation Process

The process used by the TWG to determine whether the simulated operation meets the target level of safety may be summarized as follows:

- Conduct the real-time simulation and determine the number of at-risk WCBs and the number of TCVs.

- Validate the observed TCVs.

- Compute the TCV rate of the triple approach by dividing the number of valid TCVs from both adjacent runway pairs by the total number of at-risk WCBs.

- Calculate a 99-percent confidence interval for triple approach TCV rate using standard statistical techniques (confidence interval for the proportion parameter of a binomial distribution).

- Compute the TCV rate of each of the adjacent runway pairs by dividing the number of valid TCVs for each pair by the number of at-risk blunders that were performed on that pair.

- Calculate 99-percent confidence intervals for each adjacent runway pair TCV rate using standard statistical techniques.

- Use controller, pilot, and aircraft response data to conduct a Monte Carlo simulation of at least 100,000 at-risk WCBs, as discussed in Appendix B. Record the number of TCVs observed.

- Calculate the TCV rates for the Monte Carlo simulations by dividing the number of TCVs observed in the Monte Carlo simulations by the number of at-risk WCBs. In the case of triple approaches, compute the aggregate rate and compute the rate for each adjacent pair of runways.

- Calculate 99-percent confidence intervals for each TCV rate using standard statistical techniques (confidence interval for the proportion parameter of a binomial distribution). In the case of triple approaches, compute confidence intervals for the aggregate rate and for each adjacent pair of runways.

- Compare the rates, along with their confidence intervals, of the real-time simulation with the rates and confidence intervals of the Monte Carlo simulation to ensure that the Monte Carlo and real-time simulations produce consistent results.

- If the simulations have not produced consistent results, then conduct additional analyses to reconcile the Monte Carlo and real-time test results.

- If the test results are consistent and the upper limit of the 99-percent confidence intervals for the aggregate Monte Carlo simulation is less than 5.1 percent and the upper limit of the 99-percent confidence intervals for each adjacent pair of runways is less than 6.8 percent, then the tested operation has an acceptable risk of collision.

C.7 Results of the Risk Assessment

In the real-time simulation, the target proportion of heavy jets was 30 percent. The actual proportion of heavy jets achieved was 28.8 percent. The proportion of heavy jets is important since the TCV rate depends on the proportion of heavy jets (see Table B-7). Analysis of the real-time simulation indicated that 125 at-risk, worst case blunders occurred on the three parallel approaches and 3 TCVs occurred. This resulted in an observed TCV rate for the triple approach of 2.4 percent. The 99-percent upper confidence limit for the TCV rate was 8.51 percent and the lower confidence limit was 0.27 percent. Since the maximum allowable TCV rate for triple approaches is 5.1 percent and since 5.1 percent is between 2.4 percent and 8.51 percent, the MPAP researchers considered the result of the real-time simulation risk assessment to be inconclusive.

Analysis of the real-time simulation indicated that 67 at-risk, worst case blunders occurred with the 4000-ft spaced pair of adjacent runways. Of those, 2 resulted in TCVs. The observed TCV rate is 2.985 percent. The lower confidence limit is 0.156 percent and the upper confidence limit is 13.112 percent. Since the maximum allowable TCV rate for dual approaches is 6.8 percent and since 6.8 percent is between 2.985 percent and 13.112 percent, the MPAP researchers considered the result of the real-time simulation risk assessment for the 4000-ft spaced pair of adjacent runways to also be inconclusive.

Analysis of the real-time simulation indicated that 58 at-risk, worst case blunders occurred with the 5300-ft spaced pair of adjacent runways. Of those, 1 resulted in a TCV. The observed TCV rate is 1.724 percent. The lower confidence limit is 0.00864 percent and the upper confidence limit is 12.123 percent. Since the maximum allowable TCV rate for dual approaches is 6.8 percent and since 6.8 percent is between 1.724 percent and 12.123 percent, the result of the real-time simulation risk assessment for the 5300-ft spaced pair of adjacent runways is also inconclusive. Therefore, the analysis of the real-time simulation is inconclusive and it is necessary to rely on the Monte Carlo simulation for resolution of the problem.

In Table B-7, the heavy jet proportion that most closely matches the real-time proportion of heavy jets is 30 percent. The triple approach TCV rate determined from the Monte Carlo simulation for 30 percent heavy jets is 0.899 percent with a lower confidence limit of 0.824 percent and an upper confidence limit of 0.979 percent. Clearly, the confidence interval for the triple approach derived from the Monte Carlo simulation intersects the confidence interval derived from the real-time simulation. Since the upper confidence limit of the Monte Carlo simulation is less than 5.1 percent, the TCV rate for the triple approach is acceptable.

The dual approach TCV rate from the Monte Carlo simulation for the 4000-ft spaced pair of adjacent runways is 1.796 percent with a lower confidence limit of 1.647 percent and an upper confidence limit of 1.954 percent. Since the confidence interval for the TCV rate determined from the real-time simulation intersects the confidence interval derived from the Monte Carlo simulation, the simulations of the 4000-ft spaced pair of runways are consistent. Since the acceptable maximum TCV rate as determined by the TWG is 6.8 percent for dual approaches, the TCV rate from this Monte Carlo simulation is also acceptable.

The dual approach TCV rate from the Monte Carlo simulation for the 5300-ft spaced pair of adjacent runways is 0.002 percent with a lower confidence limit of 0.00001 percent and an upper confidence limit of 0.0149 percent. Since the confidence interval for the TCV rate determined from the real-time simulation intersects the confidence interval derived from the Monte Carlo simulation, the simulations of the 5300-ft spaced pair of runways are consistent. Since the acceptable maximum TCV rate as determined by the TWG is 6.8 percent for dual approaches, the TCV rate from this Monte Carlo simulation is also acceptable.

Having found that all the simulations are consistent and that each of the upper confidence limits of the Monte Carlo simulations are less than the maximum TCV rates established by the MPAP TWG, the conclusion of the risk analysis is that the simulated triple approach operation met the target level of safety and is acceptable.

Appendix D

Controller Briefing

CONTROLLER BRIEFING
FOR THE
MULTIPLE PARALLEL APPROACH PROGRAM
SIMULATION

April 15-26, 1996

William J. Hughes Technical Center

Atlantic City International Airport, NJ

OVERVIEW

THE MULTIPLE PARALLEL APPROACH PROGRAM (MPAP) TECHNICAL WORK GROUP (TWG)

- Investigates the use of triple, quadruple, and closely spaced dual parallel runway configurations through the conduct of real-time simulations.
- Comprised of Federal Aviation Administration representatives from the Secondary Surveillance Product Office, Office of System Capacity, Flight Standards Service, Air Traffic Rules and Procedures Service, Office of Air Traffic System Management, Air Traffic Plans and Requirements, the Southwest Region, and the William J. Hughes Technical Center.

PROGRAM GOALS

- To increase airport capacity by conducting multiple simultaneous parallel ILS approaches, including:

  - triple and quadruple parallel runways.

  - closely spaced dual parallel runways.

- To examine operational issues and make recommendations for the establishment of national standards for multiple simultaneous parallel ILS approaches.

DEFINITIONS

(As defined for this simulation)

Blunder - An unexpected turn by an aircraft already established on the localizer toward another aircraft on an adjacent approach.

Breakout - A technique used to direct aircraft out of the approach stream. In the context of close parallel operations, a breakout is used to direct an aircraft away from a deviating aircraft while simultaneous operations are being conducted.

CPA - [Closest Point of Approach] The smallest slant range distance between two aircraft involved in a conflict. The distance is measured from the center of each aircraft.

NBO - [Nuisance Breakout] An event that occurs when an aircraft is broken out of its final approach for reasons other than a blunder, loss of longitudinal separation, or lost beacon signal (i.e., aircraft goes into coast).

NOZ - [Normal Operating Zone] The operating zone within which aircraft flight remains during independent simultaneous parallel ILS approaches.

NTZ - [No Transgression Zone] A 2000-ft wide zone located an equal distance between parallel runway final approach courses, in which flight is not allowed.

TNSE - [Total Navigation System Error] The difference between the actual flight path of the aircraft and its intended flight path. It is caused by flight technical error, avionics error, ILS signal error, and weather.

SIMULATION PURPOSE

- To evaluate the feasibility of and make recommendations on the air traffic control system's ability to support:

  Simultaneous ILS approaches to three parallel runways spaced 4000 and 5300 feet apart using the Precision Runway Monitor (PRM) system.

- To evaluate procedures and operational issues, NOT individual controller performance.

PRM VIDEO

DISCREPANCIES FROM VIDEO

<u>VIDEO</u>:	<u>SIMULATION</u>:
• Parallel Runway Monitor	Precision Runway Monitor
• Active expansion	4:1 expansion ratio
• Yellow alert zone	No Transgression Zone only
• Adjustable deviation lines	200-ft interval deviation lines
• 3-line data block	2-line data block w/ time share
• Adjustable predictor lines	10-second predictor lines
• Adjustable target trails	5-second target trails
• "Caution," Call Sign	Call Sign only

PRM SYSTEM

- The PRM system consists of:

    - Final Monitor Aid display
    - E-Scan radar system
    - 1.0-second radar update rate

- The FMA display is a high resolution 20 x 20-inch color monitor which displays the following close parallel approach information at an expansion ratio of 4:1:

    - No Transgression Zone (NTZ)

        - Outlined in red
        - 2,000 feet wide
        - Equidistant between ILS approach courses
        - Extends 1/2 mile beyond departure ends of the runways

    - Deviation lines

        - Solid white lines
        - 200-ft intervals from ILS localizer course

    - Extended runway centerlines

        - Dashed white lines
        - Each dash and each space equal to 1 nautical mile (nm)

  The display intensity may be adjusted as desired. All other variables of the display must remain constant.

- An aircraft predictor line is a straight line projecting from the aircraft target. The predictor line shows where the aircraft will be in 10 seconds if the aircraft continues at its current velocity and heading.

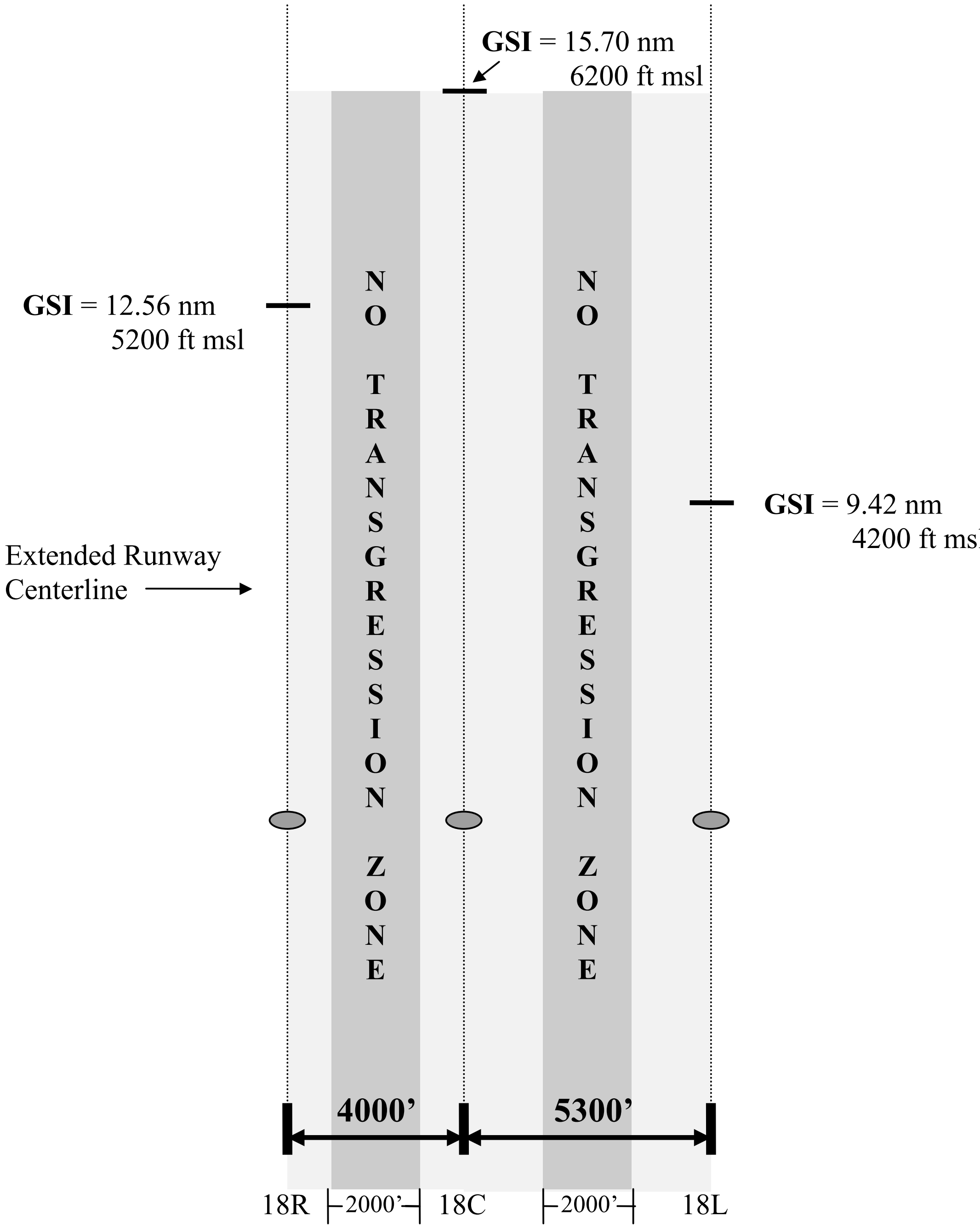
- When an aircraft is within 10 seconds of entering the NTZ, the aircraft target and data block changes from green to yellow. Also at this time, an auditory alert sounds, giving the call sign of the deviating aircraft. When an aircraft enters the NTZ, the aircraft target and data block changes from yellow to red.

AIRPORT APPROACH AREA CONFIGURATION

The simulated generic airport, referred to as Charlie Airport, is configured as follows:

- Three parallel runways
    - Spaced 4000 and 5300 feet apart
    - 10,000 feet in length
    - Even thresholds
- Glide slopes of 3 degrees
- Outer markers located 5 nm from the runway thresholds
- Field elevation of 1200 feet msl
- Minimum vectoring altitude (MVA) of 2500 feet msl

AIRPORT CONFIGURATION



Airport Elevation:	1200 ft msl
Runways:	10,000 ft x 150 ft
Weather:	200 ft ceiling and 1/2 mile visibility
Mag Variation:	0
Altimeter:	29.92

APPROACH PLATE 18R

TWGESSEN CHARTS 14 AUG 95 11-1

CHARLIE, USA

ATIS Arrival	XXX.X	
CHARLIE Approach (R)	XXX.X	
CHARLIE Tower Rwys	**18R-36L**	**132.5**
127.2	18C-36C	
120.5	18L-36R	

2700'

MSA LARRY OM

CHARLIE INTL

ILS Rwy 18R

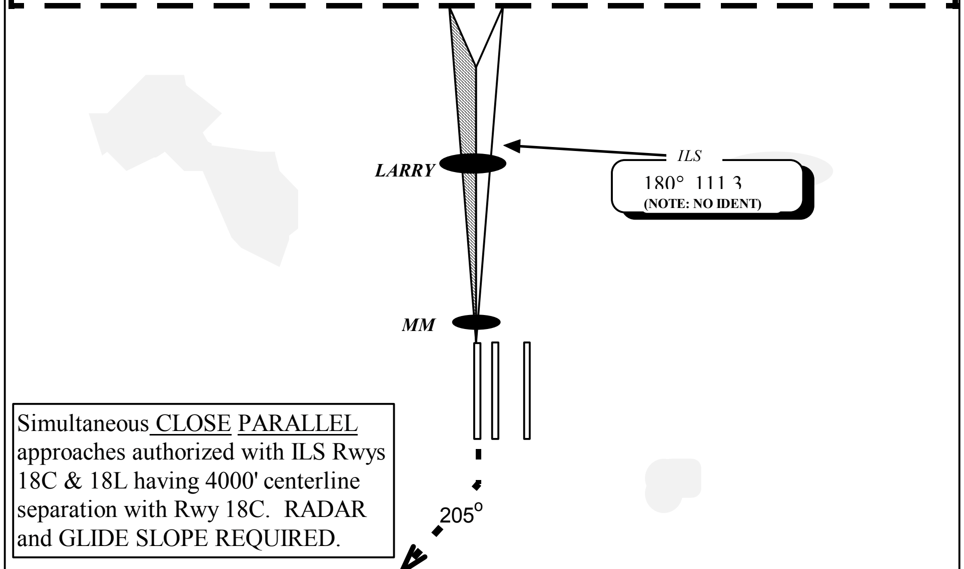
(CLOSE PARALLEL)

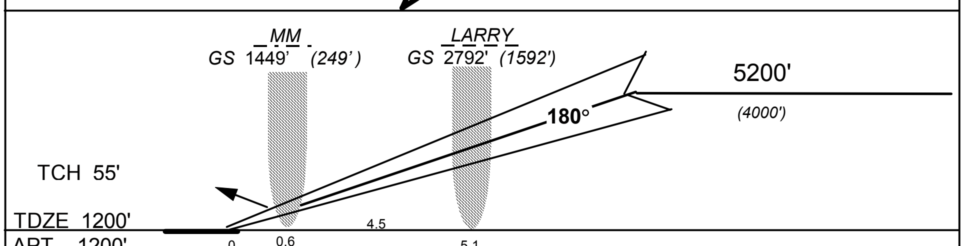
LOC 111.3

(NOTE: NO IDENT)

Apt. Elev

11-0 MUST BE READ PRIOR TO FLYING THIS CLOSE PARALLEL APPROACH





MISSED APPROACH: Climb to 500' then climbing right turn to 5000' via heading 205° and expect radar vectors.

	STRAIGHT - IN - LANDING RWY **18R** ILS DA(H) **1400'** *(200')* FULL	TDZ or CL out	ALS out	**LOC (GS Out)**		CIRCLE - TO - LAND MDA
A B C D	RVR **18** or 1/2	RVR **24** or 1/2	RVR **40** OR 3/4	**Not Authorized**	A B C D	**Not Authorized**

Gnd speed - Kts		70	90	100	120	140	160
GS	3.00°	378	486	540	648	756	864

APPROACH PLATE 18C

TWGESSEN CHARTS 14 AUG 95 11-3

CHARLIE, USA

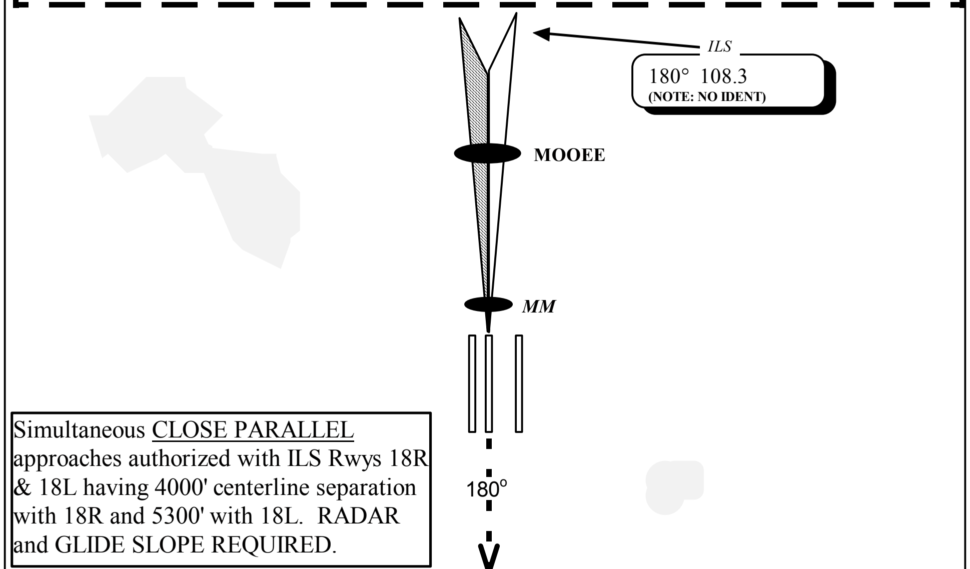
CHARLIE INTL
ILS Rwy 18C
(CLOSE PARALLEL)
LOC 108.3
(NOTE: NO IDENT)

ATIS Arrival		**XXX.X**
CHARLIE Approach (R)		**XXX.X**
CHARLIE Tower Rwys	**18C-36C**	**127.2**
	18L-36R	**120.5**
	18R-36L	**132.5**
Ground		**121.9**

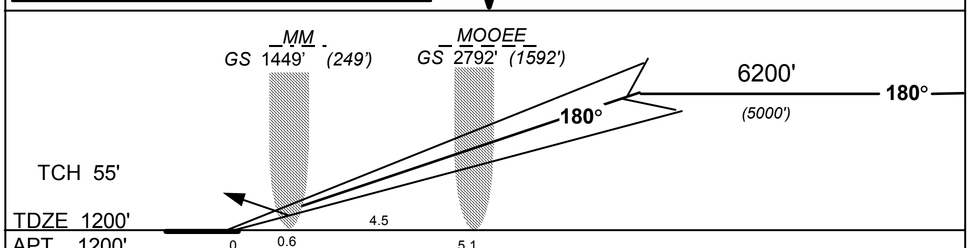
2700' *MSA* *MOOEE OM*

Apt. Elev **1200'**

11-0 MUST BE READ PRIOR TO FLYING THIS CLOSE PARALLEL APPROACH



Simultaneous CLOSE PARALLEL approaches authorized with ILS Rwys 18R & 18L having 4000' centerline separation with 18R and 5300' with 18L. RADAR and GLIDE SLOPE REQUIRED.



MISSED APPROACH: Climb to 6000' via heading 180° and expect radar vectors.

	STRAIGHT - IN - LANDING RWY **18C** ILS DA(H) **1400'** *(200')*			**LOC (GS Out)**	CIRCLE - TO - LAND MDA
	FULL	TDZ or CL out	ALS out		
A B C D	RVR **18** or 1/2	RVR **24** or 1/2	RVR **40** OR 3/4	**Not Authorized**	**Not Authorized**

Gnd speed - Kts		70	90	100	120	140	160
GS	3.00°	378	486	540	648	756	864

APPROACH PLATE 18L

TWGESSEN CHARTS 14 AUG 95 11-2

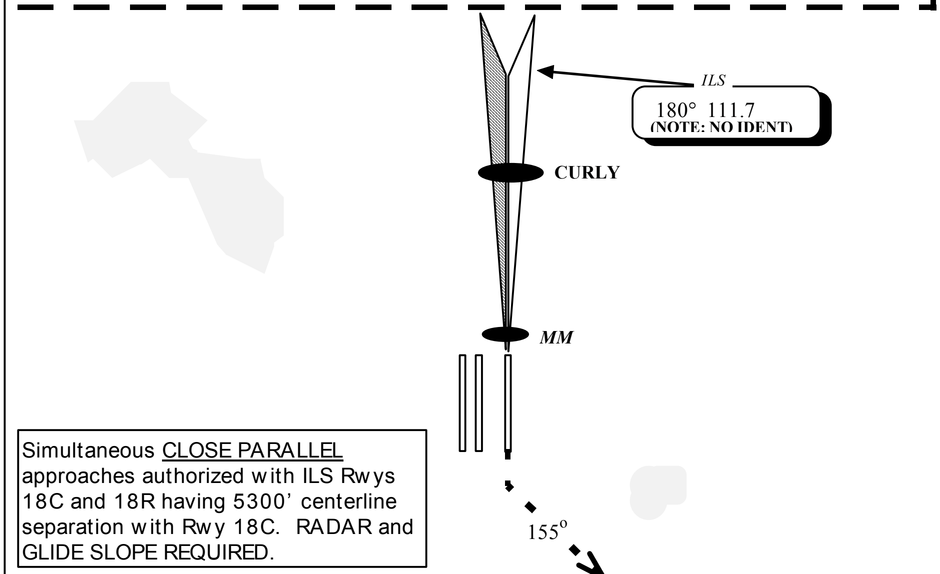
CHARLIE, USA

CHARLIE INTL
ILS Rwy 18L
(CLOSE PARALLEL)
LOC 111.7
(NOTE: NO IDENT)
Apt. Elev **1200'**

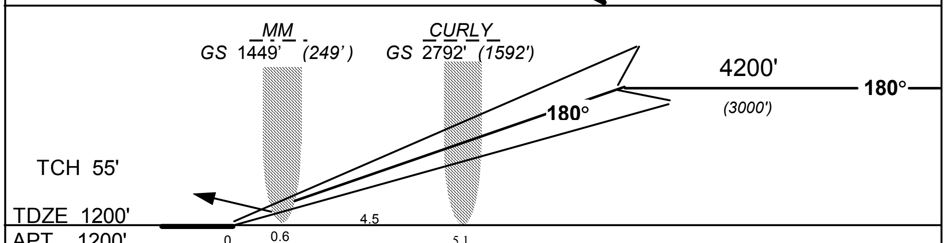
ATIS Arrival		**XXX.X**
CHARLIE Approach (R)		**XXX.X**
CHARLIE Tower Rwys	**18L-36R**	**120.5**
	18C-36C	**127.2**
	18R-36L	**132.5**
Ground		**121.9**

2700'
MSA
CURLY OM

11-0 MUST BE READ PRIOR TO FLYING THIS CLOSE PARALLEL APROACH



Simultaneous CLOSE PARALLEL approaches authorized with ILS Rwys 18C and 18R having 5300' centerline separation with Rwy 18C. RADAR and GLIDE SLOPE REQUIRED.



MISSED APPROACH: Climb to 500' then climbing left turn to 4000' via heading 155° and expect radar vectors.

	STRAIGHT - IN - LANDING RWY **18L** ILS DA(H) **1400'** (200') FULL	TDZ or CL out	ALS out	LOC (GS Out)	CIRCLE - TO - LAND MDA
A B C D	RVR **18** or 1/2	RVR **24** or 1/2	RVR **40** OR 3/4	**Not Authorized**	**Not Authorized**

Gnd speed - Kts		70	90	100	120	140	160
GS	3.00°	378	486	540	648	756	864

CONTROLLER RESPONSIBILITY

- You are the final monitor controller. Your responsibility is to maintain longitudinal and lateral separation from aircraft on the adjacent localizer between the simultaneous approach fixes to 1/2 mile beyond the departure ends of the runways.

- The aircraft will be established on the localizer and displayed on the FMA. You must ensure that each aircraft has established contact with the tower prior to the first simultaneous ILS approach fix.

- <u>OVERVIEW OF RESPONSIBILITY</u>:

All turn-ons and final approaches are monitored by radar. Since the primary responsibility for navigation rests with the pilot, instructions from the controller are limited to those necessary to ensure separation between aircraft. Information and instructions are issued, as necessary, to contain the aircraft flight path within the Normal Operating Zone (NOZ). Aircraft which are observed to enter the No Transgression Zone (NTZ) are instructed to alter course left or right, as appropriate, to return to the desired course. Unless altitude separation is assured between aircraft, immediate action must be taken by the controller monitoring the adjacent parallel approach course to require the aircraft in potential conflict to alter its flight path to avoid the deviating aircraft.

(FAA Order 7210.3K, p 12-45f)

- <u>OVERRIDE CAPABILITIES</u>:

Separate monitor controllers, each with transmit/receive and override capability on the local control frequency, shall ensure aircraft do not penetrate the depicted NTZ.

(FAA Order 7110.65J, p 5-9-7b.6 note 1)

- <u>NO TRANSGRESSION ZONE (NTZ)</u>:

The primary responsibility for navigation on the final approach course rests with the pilot. Control instructions and information are issued only to ensure that aircraft do not penetrate the NTZ. (FAA Order 7110.65J, p 5-9-7b.5).

Controller Responsibility (Continued)

- <u>FINAL MONITOR WORK PAD</u>:

Controllers shall use a pad to keep track of aircraft as follows:

1. Determine approach sequence from data block and write down aircraft call sign.
2. Place a check mark beside the call sign when the aircraft checks on tower frequency.
3. Draw a line through the aircraft call sign when radar monitoring is terminated for that aircraft.

- <u>CONTROL INSTRUCTIONS</u>:

The aircraft is considered the center of the digitized target for that aircraft for the purposes of ensuring an aircraft does not penetrate the NTZ.

1. Instruct the aircraft to return immediately to the correct final approach course when the aircraft is observed to overshoot the turn-on or continue on a track which will penetrate the NTZ.

Phraseology:

"YOU HAVE CROSSED THE FINAL APPROACH COURSE. TURN (left/right) IMMEDIATELY AND RETURN TO LOCALIZER/AZIMUTH COURSE."

or

"TURN (left/right) AND RETURN TO THE LOCALIZER/AZIMUTH COURSE."

2. Instruct aircraft:

   a. That have entered the NTZ or are established on a track that will enter the NTZ to alter course.

   b. On the adjacent final approach course to avoid a deviating aircraft.

Controller Responsibility (Continued)

Phraseology:

"TRAFFIC ALERT, (A/C call sign) TURN (left/right) IMMEDIATELY HEADING (degrees), CLIMB AND MAINTAIN (altitude)."

(Change to FAA Order 7110.65 as of June 1, 1996)

3. Standard breakout instructions for the simulation are as follows:
   - a. Runway 18R: TURN **RIGHT** IMMEDIATELY HEADING **TWO SEVEN ZERO**, CLIMB AND MAINTAIN **SIX THOUSAND**.
   - b. Runway 18C: No standard breakout. Controller's discretion.
   - c. Runway 18L: TURN **LEFT** IMMEDIATELY HEADING **ZERO NINE ZERO**, CLIMB AND MAINTAIN **FIVE** THOUSAND.
4. As soon as feasible exchange traffic and wake turbulence information.

- SPEED ADJUSTMENT:

Do not assign speed adjustment to aircraft inside the final approach fix on final or a point 5 miles from the runway, whichever is closer to the runway.

(FAA Order 7110.65J, p 5-7-1b.4)

PILOT VIDEO

COMMUNICATION

- NORDO Aircraft
- Blocked Communications

CONTROLLER PARTICIPATION

- A total of 12 monitor controllers (6 each week) will participate throughout the simulation.
- Three two-hour runs will be conducted each day.
- Controllers will rotate midway through each run.
- Controllers will not be scheduled to participate more than one hour per two-hour run, and will not participate more than three hours a day.
- Controller assignments will be equally divided with respect to runways and traffic scenarios.
- Controllers will randomly choose letter identification codes to ensure anonymity. The letters should be used for marking questionnaires and referred to when reading the controller schedule.
- Controllers will be required to complete a questionnaire at the end of the simulation.

CONTROLLER SCHEDULE

April 15-26, 1996

DATE	RUN	18R	18C	18L
4/15	P1a	A	B	C
Monday	P1b	D	F	E
	P2a	E	C	B
	P2b	F	A	D
	P3a	B	E	A
	P3b	C	D	F
4/16	P4a	E	A	C
Tuesday	P4b	F	B	D
	P5a	A	E	F
	P5b	D	C	B
	P6a	C	F	A
	P6b	B	D	E
4/17	P7a	D	C	E
Wednesday	P7b	F	A	B
	P8a	B	E	C
	P8b	A	D	F
	P9a	J	I	K
	P9b	L	G	H
	P10a	H	K	I
	P10b	G	J	L
4/18	P11a	K	G	I
Thursday	P11b	L	H	J
	P12a	G	K	L
	P12b	J	I	H
	P13a	I	L	G
	P13b	H	J	K
4/19	P14a	G	H	I
Friday	P14b	J	L	K
	P15a	K	I	H
	P15b	L	G	J
	P16a	H	K	G
	P16b	I	J	L

CONTROLLER SCHEDULE (cont'd)

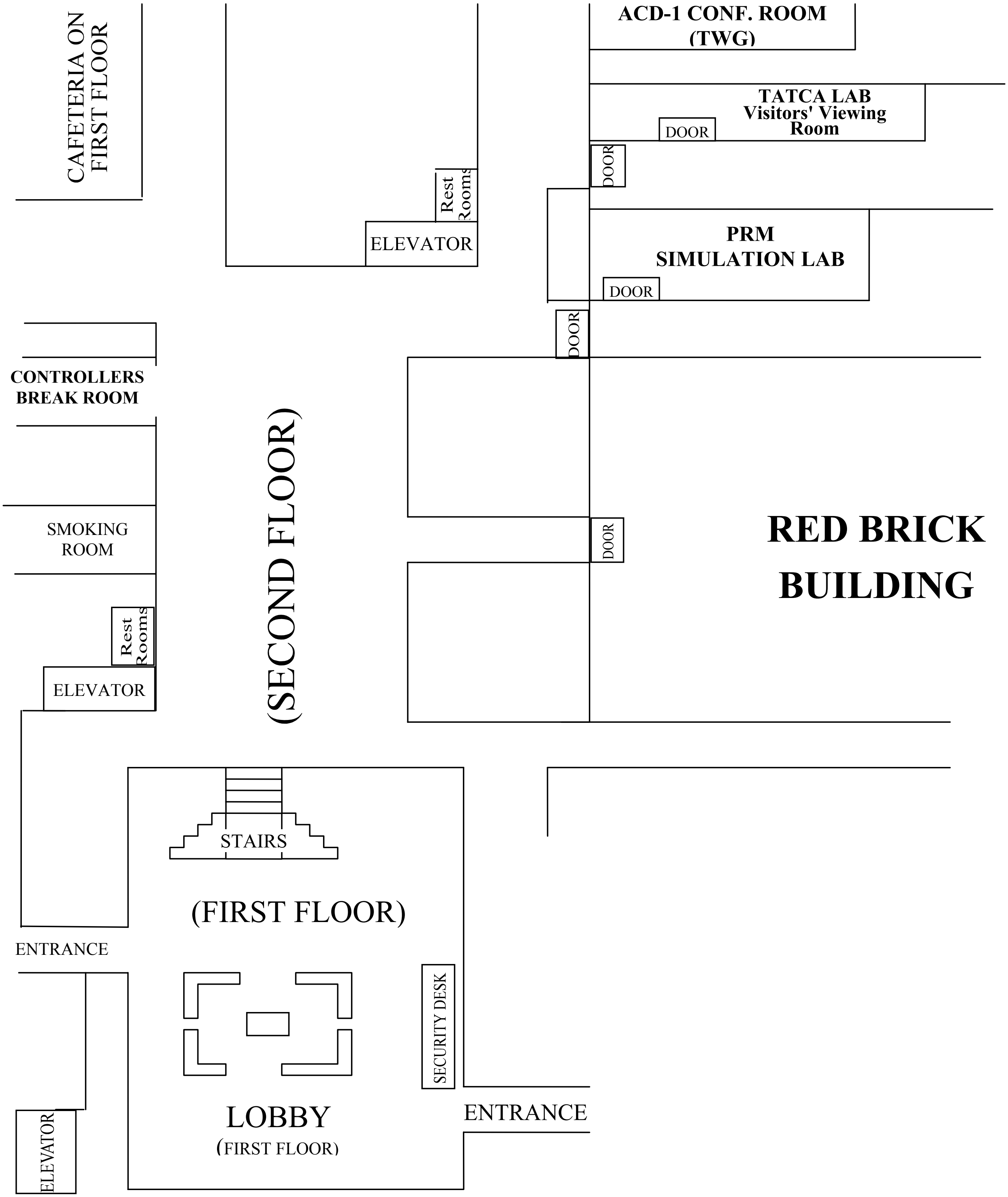
April 15-26, 1996

DATE	RUN	18R	18C	18L
4/22	1a	J	G	L
Monday	1b	H	I	K
	2a	K	L	H
	2b	G	J	I
	3a	L	H	G
	3b	I	K	J
4/23	4a	H	J	L
Tuesday	4b	K	G	I
	5a	I	H	J
	5b	G	L	K
	6a	J	I	H
	6b	L	K	G
4/24	7a	G	I	H
Wednesday	7b	L	J	K
	8a	H	G	L
	8b	I	K	J
	9a	A	D	F
	9b	C	B	E
4/25	10a	D	A	B
Thursday	10b	F	C	E
	11a	A	B	F
	11b	C	E	D
	12a	B	D	C
	12b	E	F	A
4/26	13a	A	B	C
Friday	13b	D	E	F
	14a	F	A	B
	14b	E	C	D
	15a	B	F	A
	15b	C	D	E

CONTROLLER QUESTIONNAIRES

- You will be required to complete two different types of questionnaires during and following the simulation:
  - Blunder Statement
  - Post-Simulation Questionnaire
- You will receive a Blunder Statement from the technical observer monitoring your position following each run in which two aircraft come within a close proximity of one another.
- You will receive a Post-Simulation Questionnaire from the designated technical observer during the de-briefing session on the last day of your participation in the simulation.
- It is important that you answer the questions carefully and return the completed questionnaires to the technical observers in a timely manner.

FAA TECHNICAL CENTER LAYOUT



Appendix E

Pilot Briefing

PILOT BRIEFING

FAA APPROACH SIMULATION

April 22-26, 1996
FAA Technical Center
Atlantic City International Airport, NJ

INTRODUCTION

- Welcome to this FAA simulation. Your cooperation in this project is greatly appreciated. By participating in this simulation you will assist in providing data that will help enhance air safety and increase the arrival capacity at many airports nationwide.

- In this simulation you will be flying about 4 to 6 ILS approaches per hour to a fictitious airport called CHARLIE INTERNATIONAL. You will be positioned at a point located about 20 NM from the threshold at an intercept heading of 20 degrees to the localizer.

- **Please bring your airline's final approach checklist for the aircraft you are assigned to with you to the simulation.** Your entire flight kit will not be needed. You will be using the simulator's headset and microphones through which you will hear ATC and other aircraft. All the necessary approach plates will be provided.

- We will be videotaping and sound recording the entire simulation. Pilots and their airlines will not be identified. Videotaping has proved to be a helpful tool to non pilot researchers who are unfamiliar with cockpit procedures and who do not realize the workload involved during final approach.

- We will request your social security number and pilot license number for payroll purposes only. You will receive a check 5 to 6 weeks after completing this simulation. If you do not receive payment within 6 weeks, please call the SRC Pilot Group at .

- Thank you once again for your participation. We look forward to working with you.

FLIGHT SIMULATOR PROCEDURES

- The site coordinator will be your contact during the simulation. Refer to the enclosed letter for his name and phone number.

- Before each approach the site coordinator will provide you with a card containing the following information:

    - **Transponder code** - it is very important to squawk the proper code since this is used in exchanging data with the FAA Technical Center.

    - **Approach type** - whether the approach will be flown using a coupled autopilot, or handflown using the flight director. For those pilots flying the General Aviation simulator you may be requested to fly a raw data approach.

    - **Runway -** the runway to which you are making the approach.

    - **Altitude** - this will be the same as the intercept altitude on the approach plates provided at the simulation briefing.

    - **Call sign** - this will probably be another airline other than your own. In order to prevent mistakes, it will be helpful to say your call sign out loud prior to simulator release.

    - **Airspeed** - the given IAS must be maintained to the OM, unless otherwise directed by ATC.

    - **Aircraft type/equipment** - most of the time the aircraft on the card will be different than the simulator you are flying. This is the aircraft type that will be displayed on the tag attached to your radar target . The controller will think your aircraft is this type, so don't be surprised if he refers to you as a B-737, etc. You will still fly the simulator as you would normally.

    - **ILS Localizer and Tower Frequencies** - these correspond to frequencies found on the approach plates and are displayed on the card for your convenience.

    - **ATIS** - weather will remain the same for each two hour period; however, each of the the three ATIS cards will correspond to a different wind direction.

    - Please use the simulator pre-release checklist to ensure each of the above items is correctly set.

- Pilots will be provided with the required experimental approach plates which will vary slightly from the current JEPPESEN format. These plates represent our fictitious airport called CHARLIE INTERNATIONAL.

- You will be released from position freeze on a 20 degree intercept heading to the localizer at about 20 NM from the threshold.

- **When released you must assume you have just been told by Approach Control to contact Charlie tower when established on the localizer and about 17 miles out**. You will remain on the same frequency during the entire approach phase.

- The site coordinator will tell you when each approach exercise ends.

- The site coordinator will assign new altitude, heading, airspeed and transponder code after the approach is completed so that you can setup for the next approach.

PILOT RESPONSIBILITIES

You will be using call signs that differ from your airline, so it is very important to listen carefully for the correct call sign. It will be helpful to repeat the call sign out loud before starting each approach. The index card for each approach will have your call sign printed on it. Please put it where both pilots can see it.

- Maintain a sterile cockpit in accordance with the FAR's and the approach environment. Remember that cockpit conversation will be recorded.
- If paired with an unfamiliar crewmember or a pilot from another company, review and establish individual cockpit duties to be used during all the approaches.
- Complete the approach briefing and any checklists that are required prior to the final check before being released from position freeze.
- Review the simulator pre-release checklist to ensure the correct parameters are set prior to leaving the Initial Point (IP).
- Do not discuss this simulation with other crewmembers who will be participating.
- Answer questions from the site coordinator after selected approaches.
- Complete the Flightcrew Opinion Survey at the end of your participation.

QUESTIONNAIRE ADMINISTRATION

- At the end of your participation in the simulation, you will complete a Flightcrew Opinion Survey. Only one survey should be completed throughout your participation. Return your completed survey to the site coordinator before you leave the simulator area.

- This is a unique opportunity for today's line pilot to participate in the research and the development of ATC procedures. Any comments, recommendations, or ideas provided from your direct participation will be used to form a foundation that will help shape the future of the National Airspace System.

SIMULATOR PRE-RELEASE CHECKLIST

TRANSPONDER..______SET

INTERCEPT HEADING...______DEG, SET

ALTITUDE...LEVEL______FT, SET

AIRSPEED **TO BE MAINTAINED UNTIL OM**............______KIAS, SET

LOCALIZER..______SET, FOR RWY______

TOWER FREQ...______SET, FOR RWY______

APPROACH MODE (IF APPLICABLE)..ARMED

AUTOTHROTTLE (IF APPLICABLE)...ARMED

CALL SIGN...__________

SIMULTANEOUS CLOSE PARALLEL ILS APPROACHES

At 180 kts. an aircraft that has entered the No Transgression Zone can cross the adjacent parallel course centerline in as little as ***NINE SECONDS***. Inattention, or failure to expeditiously comply with a final monitor controller's breakout instructions could result in a midair collision. Remember, you are being broken off the ILS because an aircraft from the adjacent ILS has probably deviated off course and is **HEADING YOUR WAY**. When pilots hear or read the word "CLOSE" in association with simultaneous parallel approaches, they should be especially aware that any instructions issued by a controller should be immediately followed.

This Flight Operations Bulletin imparts important information necessary for pilots to attain the increased level of pilot awareness required for safe, efficient, simultaneous close parallel ILS approach operations. Important pilot questions of "why", " how will I know", "what can I expect", and "what will I do" are answered. Hopefully, "SIMULTANEOUS CLOSE PARALLEL ILS APPROACHES" will be put on your list of important aviation terms or "buzzwords".

WHY?

Increased crew awareness is necessary because in all probability, there is an aircraft operating on the adjacent parallel localizer course as close as 3400' from your wingtip. Failure to comply with ATC clearances, tune the proper localizer frequency, accurately track the localizer course centerline, or respond to controller breakout instructions in an expeditious manner are all factors that may lead to loss of lateral separation, near-midair collisions, or midair collisions. Attention to detail is mandatory!

HOW WILL I KNOW?

Key words such as **"simultaneous"** and **"close parallel"** should alert pilots of the need to increase their awareness level. ATIS will broadcast phraseology such as:

"Simultaneous Close Parallel ILS Runways (number) L/R/C Approaches in use".

For a **new approach procedure** the approach plate for close parallel approaches will be titled "CLOSE PARALLEL ILS RWY (number) R". For **existing approach procedures** a separate plate will be issued. This separate plate will have "CLOSE PARALLEL" in parenthesis under the approach name. The plates will also have the note "SIMULTANEOUS CLOSE PARALLEL APPROACHES AUTHORIZED WITH RUNWAYS (number) L/C/R and "GLIDESLOPE REQUIRED".

WHAT CAN I EXPECT?

If you or the aircraft on the adjacent localizer course fail to track the localizer course centerline (or worse yet, track the wrong localizer course!), final monitor controllers with frequency override capabilities will issue instructions. Each runway has a dedicated frequency therefore you **will not** hear final monitor radio transmissions to aircraft on the adjacent localizer course. The two scenarios requiring final monitor intervention are aircraft deviations from the localizer course centerline, and penetration of the No Transgression Zone by the aircraft on the adjacent parallel localizer course. For aircraft observed deviating from the localizer course centerline or observed to overshoot the turn-on, final monitor controllers will use phraseology such as:

"TURN (left/right) AND RETURN TO THE LOCALIZER COURSE" or "YOU HAVE CROSSED THE FINAL APPROACH COURSE. TURN (left/right) IMMEDIATELY AND RETURN TO THE LOCALIZER COURSE".

When an aircraft fails to respond to final monitor controller instructions or is observed penetrating the No Transgression Zone, the aircraft on the **adjacent** parallel localizer course(s) will be issued breakout instructions such as:

"TRAFFIC ALERT (A/C callsign) TURN (left/right) IMMEDIATELY HEADING (degrees) CLIMB/DESCEND AND MAINTAIN (altitude)".

A descending breakout is contrary to what pilots would normally expect but the pilot should be aware that ATC will use it when necessary. If the final monitor controller issues a descending breakout, the descent will not take the pilot below the Minimum Vectoring Altitude (MVA).

WHAT WILL I DO?

To ensure proper preparation for "what will I do" the approach briefing shall address the possibility of an **ATC directed breakout.** The briefing should also include how that breakout will be accomplished. Pilots must comply immediately with all final monitor controller instructions. Having been "cleared for the approach" pilots are in a "land the aircraft" mode. For this reason it feels unnatural to be broken off the approach particularly if you have the localizer and glideslope "wired". For these reasons, pilots can be tempted to question, or hesitate in complying with the final monitor controller’s breakout instructions.

During close parallel approach operations, **immediate** execution of the final monitor controller's instructions is **mandatory**. Remember, you are being broken off the approach because the aircraft assigned to the adjacent parallel localizer course has failed to respond to the final monitor controller's instructions or has entered the No Transgression Zone--the aircraft is heading your way. There is simply not enough "real estate" between you and the deviating aircraft to execute the breakout in a leisurely manner. For example, at 140 kts. ground speed an aircraft is traveling 236' per second!

YOU MUST HAND-FLY THE BREAKOUT. This is not an option. Studies have shown that hand-flown breakouts are done consistently faster than breakouts flown using the autopilot.

Crew coordination items must be thoroughly understood and briefed prior to commencement of the approach. This is particularly critical for glass cockpits. Remember, during an ATC directed breakout, you can be given any combination of turn and/or climb/descent instructions. In some airplanes a descending breakout, for example, is much more easily accomplished by hand-flying the maneuver. Think about a possible breakout before the approach and if given one you will be able to handle the maneuver safely and promptly.

PILOT AWARENESS
OPEN BOOK TEST

Pilot Awareness Training for Simultaneous Close Parallel ILS Approaches.

I. "Close Parallel" in describing a simultaneous ILS approach means:

A. Runway centerlines are less than 4,300' apart.

B. Runway centerlines might be only 3,400' apart.

C. There might be someone making an approach to the adjacent runway who is very, very close.

D. All of the above.

II. If a pilot is flying a simultaneous close parallel ILS approach and the controller tells him to turn off the localizer the pilot should:

A. Take his time because the passengers don't like sudden maneuvers.

B. Move the aircraft as quickly as practical to avoid a potential mid-air collision.

C. Not turn off the localizer, because the instruments read on course and you've been cleared for the approach.

III. Can a controller give a pilot a descending turn off the localizer when the pilot is on an ILS approach?

A. No, not if the aircraft has captured the localizer and glideslope.

B. No, all turns off the localizer must be accompanied by a climb.

C. Yes, provided the aircraft is not descended lower than the minimum vectoring altitude (MVA). If that is what it takes to avoid a collision, the controller will direct a descending turn off the localizer.

PAGE 2
OPEN BOOK TEST

IV. What are the most important things to remember about simultaneous close parallel ILS approaches?

A. Don’t make any abrupt turns because of passenger comfort, and always question every turn off the ILS localizer given by ATC.

B. If you don’t turn immediately off the localizer when directed by ATC, perhaps maybe he’ll forget about you and you can get in on time. If the controller is being unreasonable by making you late, stand your ground and don’t let him intimidate you, after all you’re an airline captain.

C. There is probably someone very close along side of you making an approach to the other runway. If ATC tells you to turn off the localizer it means that the airplane along side of you is now heading your way and it might hit you unless you move the airplane quickly.

V. When you hear ATC transmit “TRAFFIC ALERT”, what kind of message is going to follow?

A. A turn off the ILS for someone because an aircraft on the parallel runway is heading his way.

B. There is a new ATIS coming up and the controller wants everyone to listen to it.

C. The highway leading into the airport is really jammed up with cars.

VI. How should the briefing for simultaneous close parallel ILS approaches be conducted?

A. No briefing is necessary.

B. Use the standard briefing for ILS approaches.

C. Use the standard briefing for ILS approaches. Additionally brief for the "close" aspect of the approach, the possibility of an ATC directed breakout and how it should be conducted.

Answers:

1. D

2. B

3. C

4. C

5. A

6. C

Breakout Procedure Bulletin

General Discussion:

Closely spaced (less than 4300 feet between parallel runway centerlines) ILS simultaneous approaches have created the need for a "breakout" procedure. "Breakout" is defined as an ATC-directed departure from an ILS approach prior to reaching the D/H. Before the advent of closely spaced ILS simultaneous approaches, ATC rarely diverted an aircraft from an ILS approach. If a breakout was initiated by ATC, it was usually the result of a spacing problem and not a potential collision problem with another aircraft. It is forecast that closely spaced ILS simultaneous approaches will increase the frequency of breakouts and the spacing between the parallel localizers dictates that a procedure be implemented to reduce the maneuver times of the evading aircraft.

A breakout to avoid a collision is considered to be an emergency-like maneuver and extraordinary steps in the breakout procedure are needed. Although autopilot use is encouraged for a closely spaced ILS simultaneous approach, the breakout procedure will be hand flown. It is very important that the breakout transmission from ATC be followed immediately and the only way this can be accomplished quickly is by disconnecting the autopilot and hand flying the airplane through the maneuver. The pilot must keep in mind that a descent might be one of the options that the controller might use, providing the aircraft is above the minimum vectoring altitude (MVA). The pilot can count on the MVA not being below 1,000' AGL and in all probability the MVA will be considerably higher, because the MVA provides at least 1,000' clearance above obstacles.

Studies have found that using an autopilot for a breakout results in longer breakout times than when the aircraft is handflown through the maneuver. Some aircraft take longer than others when using the autopilot, but for standardization purposes, the policy will be to make all ATC-directed breakouts without the autopilot connected.

Breakout Procedure Bulletin

The following procedure is to be used when conducting an ATC-directed breakout from a closely spaced ILS simultaneous approach:

PILOT FLYING (PF):

- Disconnect autopilot and point the aircraft in the direction the controller has directed (including climb or descent).
- Monitor speed and consider disconnecting autothrottles (if applicable) or overriding with manual throttle inputs.
- Command to clean up aircraft using normal procedures.

PILOT NOT FLYING (PNF) - catch up the flight director to the aircraft's flight path:

- Turn off both flight directors
- Turn on PNF's flight director
- Set new heading.
- Set new altitude
- Make other inputs as necessary to match the flight director with the desired flight path.
- When PNF's flight director matches the desired aircraft's flight path, turn on PF's flight director.

NOTE: It is important that the PNF turn off the flight director of the PF, so that the PF does not have to "fly through" the flight director. It is not desirable to have the flight director telling the pilot to do the opposite of what ATC wants the pilot to do.

THIS BREAKOUT PROCEDURE SHOULD BE BRIEFED ALONG WITH THE NORMAL APPROACH BRIEFING PRIOR TO ALL CLOSELY SPACED SIMULTANEOUS ILS APPROACHES.

BREAKOUT PROCEDURE

OPEN BOOK TEST

1. When accomplishing a hand flown breakout the PF should:

   a. Wait for the PNF to setup the flight directors before taking any action.
   b. Immediately turn and point the aircraft (climb or descent) as directed by the controller.
   c. Leave the aircraft coupled to the Autopilot.

2. The PNF needs to turn off:

   a. Only his Flight Director.
   b. Only the flight director of the PF.
   c. Both flight directors

3. If the approach is being made on the autopilot:

   a. A breakout should be conducted on the autopilot.
   b. A breakout can be done by using the autopilot or by handflying the breakout.
   c. All breakouts must be handflown.

4. The PNF should turn on the flight director of the PF:

   a. Immediately.
   b. No urgency, the PF is experienced and has no need for a flight director.
   c. As soon as the his flight director matches the desired aircraft flight path.

5. (Answer only if aircraft has autothrottles) During hand flown breakouts the PF should:

   a. Always keep the autothrottles engaged.
   b. Consider disconnecting the autothrottles and applying manual inputs.
   c. Never use autothrottles.

Answers:

1. B

2. C

3. C

4. C

5. B

Automatic Terminal Information System (ATIS) Card

ATIS 'A'

THIS IS CHARLIE INFORMATION ALPHA.

WEATHER MEASURED 200 OVERCAST, VISIBILITY ONE HALF, FOG, TEMPERATURE 59, DEW POINT 54, WIND CALM, ALTIMETER 29.92. SIMULTANEOUS CLOSE PARALLEL ILS RUNWAYS 18L, 18C AND 18R APPROACHES IN USE.

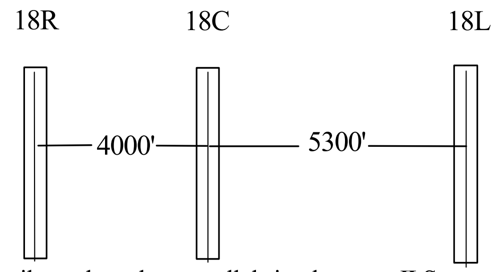
ADVISE YOU HAVE ALPHA

Appendix F

Approach Plates and Information Page

SIMULTANEOUS CLOSE PARALLEL APPROACHES
18L   18C   18R

Charlie International runway centerline separation:



The ATIS broadcast will advise pilots when close parallel simultaneous ILS approaches are in progress. If unable to comply, notify ATC immediately.

Before initiating a close parallel simultaneous ILS approach, this information bulletin must be read and the following requirements met.

1. **View the FAA video, *RDU Precision Runway Monitor: A Pilot's Approach.***

2. **All ATC directed "breakouts" (a vector off the ILS prior to the D/H) are to be handflown, unless company procedures and/or aircraft flight manual dictate otherwise.**

The term, CLOSE PARALLEL, means that one pair of runway centerlines is less than 4300' apart. At Charlie International, even though only two of the runways are under 4300' apart, when running simultaneous approaches to all three runways, all approaches are classified as close parallel.

If an aircraft is observed to be on a track that is left/right of the final approach course and may penetrate the No Transgression Zone, a 2000' wide safety zone equidistant between approach courses, the controller will provide instructions to return the aircraft to the final approach course.

"You have crossed the final approach course. Turn(left/right) IMMEDIATELY and return to the localizer azimuth/course."

OR

“Turn (left/right) and return to the localizer/azimuth course.”

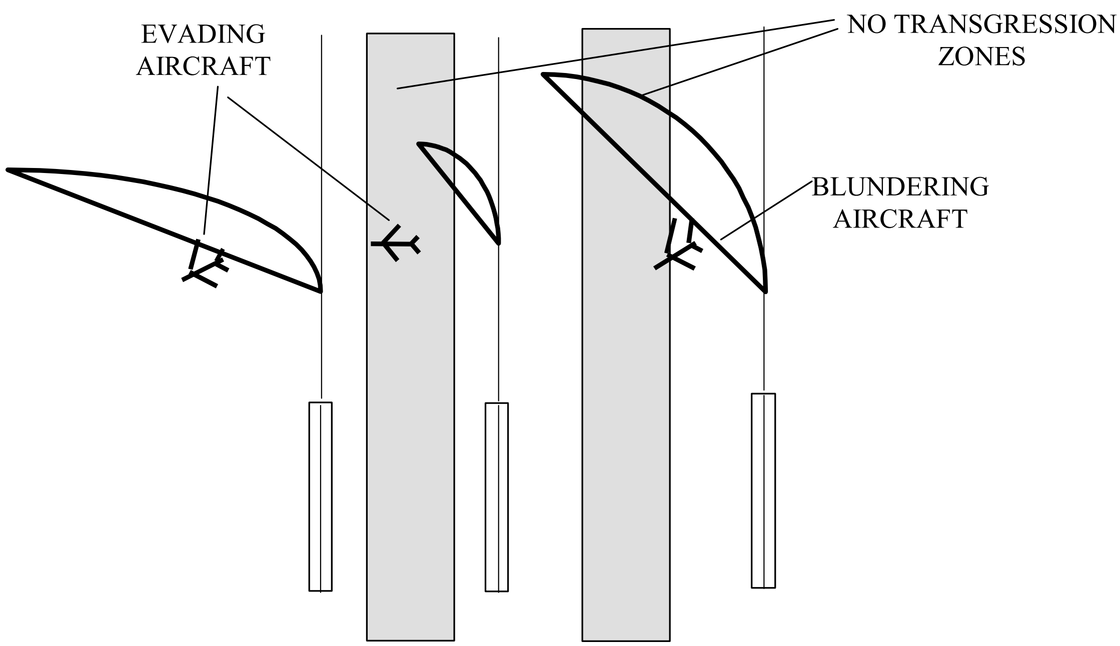
It is important that the pilot respond immediately to avoid a possible collision.

(CONTINUED ON OTHER SIDE)

If an aircraft is observed penetrating the No Transgression Zone, ATC instructions will be given to the aircraft on the adjacent final approach course(s) to alter course to avoid the deviating aircraft.

> "TRAFFIC ALERT (aircraft callsign) turn (left/right) IMMEDIATELY heading (degrees). Climb/descend and maintain (altitude)."
>
> Example:
>
> TRAFFIC ALERT, ALL AMERICA 123, TURN RIGHT IMMEDIATELY HEADING TWO SEVEN ZERO, CLIMB AND MAINTAIN FOUR THOUSAND.

An immediate pilot response is expected and required to avoid a possible collision. The pilots receiving this message will not be forewarned by hearing the transmissions to the blundering aircraft, because each approach course is being monitored by a separate frequency. When a pilot is told to breakoff the approach, the pilot must assume the worst: that an aircraft from an adjacent localizer is heading his way and that the breakout must be started immediately and continued as rapidly as safety allows.



For questions, please contact: Supervisor, Charlie TRACON, 1-800-328-7448.

TWGESSEN CHARTS 14 AUG 95

11-1

CHARLIE, USA

CHARLIE INTL

ILS Rwy 18R

(CLOSE PARALLEL)

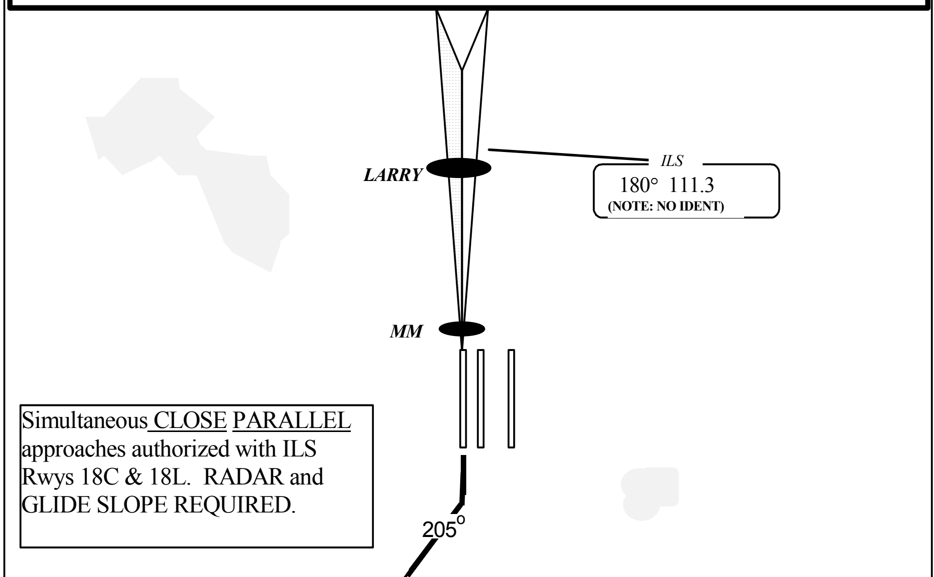
LOC 111.3
(NOTE: NO IDENT)

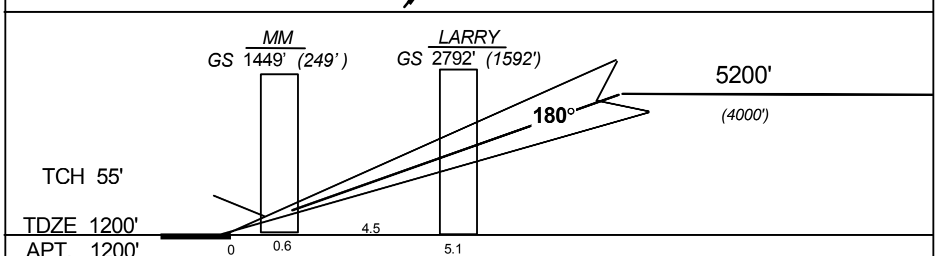
ATIS Arrival		**XXX.X**
CHARLIE Approach (R)		**XXX.X**
CHARLIE Tower Rwys	**18R-36L**	**132.5**
	18C-36C	127.2
	18L-36R	120.5
Ground		**121.9**

2700' *MSA* *LARRY OM*

Apt. Elev **1200'**

11-0 MUST BE READ PRIOR TO FLYING THIS CLOSE PARALLEL APPROACH





MISSED APPROACH: Climb to 1700' then climbing right turn to 5000' via heading 205° and expect radar vectors

	STRAIGHT - IN - LANDING RWY **18R** ILS DA(H) **1400'** *(200')*			LOC (GS Out)		CIRCLE - TO - LAND MDA
	FULL	TDZ or CL out	ALS out			
A B C D	RVR **18** or 1/2	RVR **24** or 1/2	RVR **40** OR 3/4	**Not Authorized**	A B C D	**Not Authorized**

Gnd speed - Kts	70	90	100	120	140	160
GS 3.00°	378	486	540	648	756	864

TWGESSEN CHARTS 14 AUG 95 11-2

CHARLIE, USA

CHARLIE INTL

ILS Rwy 18L

(CLOSE PARALLEL)

LOC 111.7

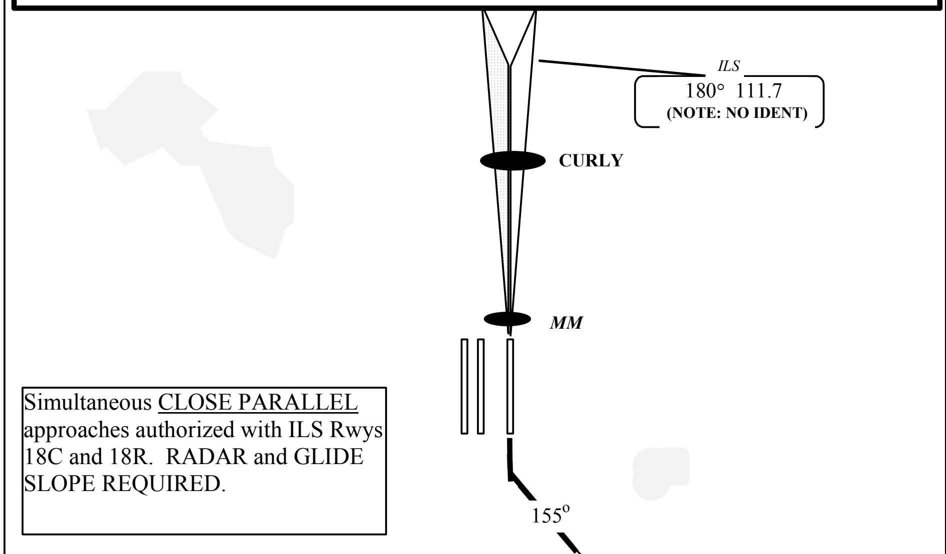
(NOTE: NO IDENT)

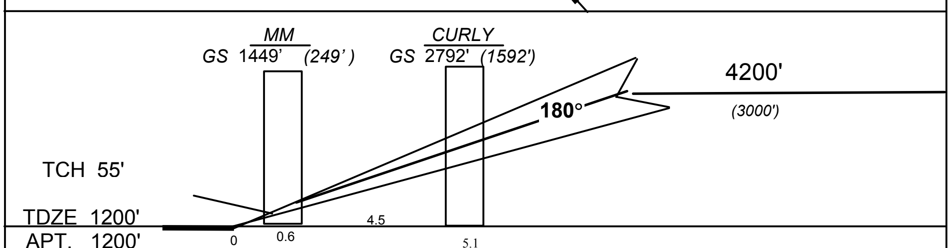
ATIS Arrival		**XXX.X**
CHARLIE Approach (R)		**XXX.X**
CHARLIE Tower Rwys	**18L-36R**	**120.5**
	18C-36C	127.2
	18R-36L	132.5
Ground		**121.9**

2700' ***MSA*** ***CURLY OM***

Apt. Elev **1200'**

11-0 MUST BE READ PRIOR TO FLYING THIS CLOSE PARALLEL APPROACH





MISSED APPROACH: Climb to 1700' then climbing left turn to 4000' via heading 155° and expect radar vectors.

	STRAIGHT - IN - LANDING RWY **18L** ILS DA(H) **1400'** *(200')* FULL	TDZ or CL out	ALS out	LOC (GS Out)		CIRCLE - TO - LAND MDA
A B C D	RVR **18** or 1/2	RVR **24** or 1/2	RVR **40** OR 3/4	**Not Authorized**	A B C D	**Not Authorized**

Gnd speed - Kts	70	90	100	120	140	160
GS 3.00°	378	486	540	648	756	864

TWGESSEN CHARTS 14 AUG 95 | 11-3

CHARLIE, USA

CHARLIE INTL

ILS Rwy 18C

(CLOSE PARALLEL)

LOC 108.3

(NOTE: NO IDENT)

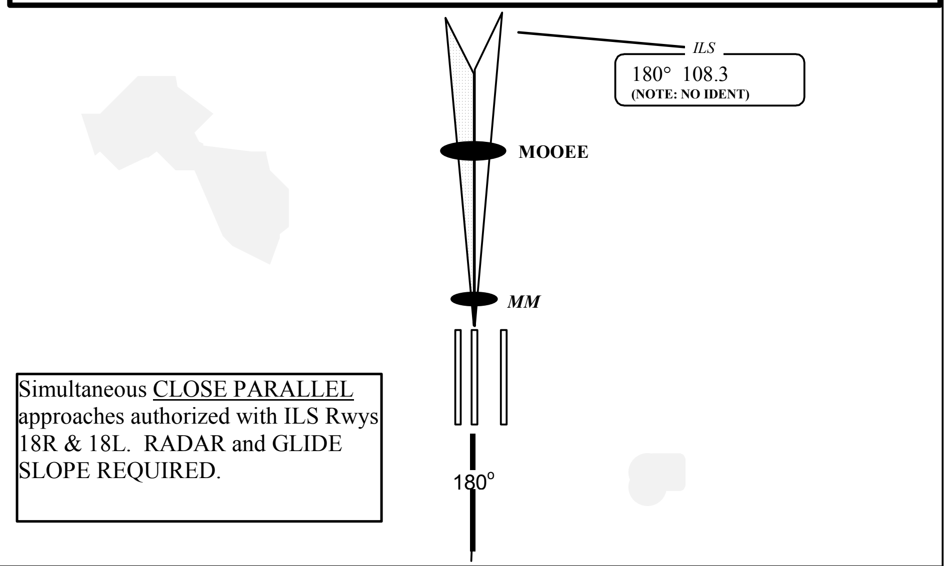
ATIS Arrival	**XXX.X**	
CHARLIE Approach (R)	**XXX.X**	
CHARLIE Tower Rwys	**18C-36C**	**127.2**
	18L-36R	120.5
	18R-36L	132.5
Ground	**121.9**	

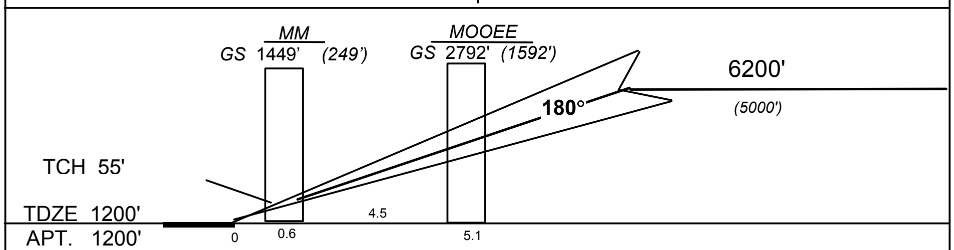
2700'

MSA

MOOEE OM ***Apt. Elev*** **1200'**

11-0 MUST BE READ PRIOR TO FLYING THIS CLOSE PARALLEL APPROACH





MISSED APPROACH: Climb to 6000' via heading 180° and expect radar vectors.

	STRAIGHT - IN - LANDING RWY **18C**				CIRCLE - TO - LAND	
	ILS DA(H) **1400'** *(200')*			**LOC (GS Out)**		
	FULL	TDZ or CL out	ALS out			MDA
A B C D	RVR **18** or 1/2	RVR **24** or 1/2	RVR **40** OR 3/4	**Not Authorized**	A B C D	**Not Authorized**

Gnd speed - Kts	70	90	100	120	140	160
GS 3.00°	378	486	540	648	756	864

Appendix G

Blunder Distribution Results

SUMMARY OF REAL-TIME SIMULATION GOALS AND ACTUAL RESULTS.

TEST CONDITION **Number of Blunders**	**Goal (%)** **N**	**Actual (%)** **N**
5/Hour; or 10/run x 15 runs =	150	153*

Blundering Aircraft Communications Status	**%**	**%**
No Communications	80.0	79.1
Communications	20.0	20.9
Blundering Aircraft Flight Path		
Maintain Altitude	50.0	41.2
Descend	50.0	58.8
Blundering Aircraft Start Course		
18L/18C	50.0	47.7
18R/18C	50.0	52.3
Blundering Distribution along Final Approach Course		
1-3 nm	20.0	19.6
3-5 nm	20.0	18.3
5-7 nm	15.0	15.0
7-9 nm	15.0	16.4
9-12 nm	20.0	19.6
12-15 nm	10.0	9.8
>15 nm (n=2; 15.31, 15.33)	0.0	1.3
Aircraft Type (Involved in Blunders)		
Jet	60.0	62.7
Heavy Jet	30.0	28.8
General Aviation	10.0	8.5
Aircraft Flight System (Involved in Blunders)		
Glass (Digital)	50.0	52.3
Conventional (Analog)	40.0	39.2
General Aviation	10.0	8.5

* Total excludes two blunders. One blunder involved two TGF targets (i.e., TGF evader) and one blunder was initiated <1nm from the runway threshold.

Appendix H

Site Coordinator Briefing

SITE COORDINATOR BRIEFING MATERIALS

FOR

FAA MPAP TWG SIMULATION

April 22-26, 1996

FAA Technical Center

Atlantic City International Airport, NJ

WELCOME

You will be participating as a site coordinator in the simulation of close parallel simultaneous ILS approaches to three parallel runways at a fictitious airport, Charlie International. The three runways of this fictitious airport are 4000' and 5300' apart. This Site Coordinator Instruction Package contains instructions about how to conduct the simulation, how to brief the pilots, how to administer the pilots and how to train the crews.

As the site coordinator, your responsibilities include insuring pilot contracts are complete and correct, briefing the pilots, administering the pilot training, providing pilots with ATIS card and run number information, documenting the approach, administering questionnaires, video taping each approach, and having the pilots complete a survey. In addition, site coordinators shall submit a brief report containing their observations during the simulation and operational issues that it addressed. You are the best source of information concerning the pilot and cockpit perspective of the approach operation being simulated. Please record any and all observations carefully and completely. At any time during the simulation, if you have a question, please do not hesitate to call a SRC representative.

GENERAL INSTRUCTIONS

1. It is very important that a professional atmosphere be maintained throughout the simulation, especially during final approaches. When the simulator is in motion, a sterile cockpit is required. Remember, the pilots are on video. A number of people will be reviewing this simulation and many are especially concerned with the professionalism of the participants. It is essential for the simulation to be conducted as close to “real world” as possible.

2. Please do not use the simulator phone lines at any time for calls other than to the Test Director at the FAA Technical Center or to contact a technician outside the simulator.

3. Please insure pilots comply with headset requirements and they use the boom mike if supplied. The use of the speaker might produce feedback into the video sound and the boom mike on some of the simulators is the source for the cockpit conversation recording.

4. You will be video taping each two hour session during the simulation. It is important to insure that communications between ATC and the pilots are captured on the tape, as well as crew interaction and cockpit conversations. During the last simulation, several simulators did not record radio traffic. Please check your tapes to determine if your site is recording ATC. Further instructions on video taping can be found later in this document.

5. Prior to each approach, stress call sign recognition with the pilots. Require each pilot to verbalize the call sign without reference to the index card and then have the pilots place the card so that each pilot can see it. We know that there will be lots of stumbles over the call sign, but by using this procedure this problem can be minimized.

6. On each approach, complete the Simulator Pre-Release Checklist. We have put the checklist and the breakout questionnaire in a plastic page protector located in the back of the 3-ring notebook.

7. The pilot flying should alternate with each approach. If there are two first officers in the seats, it's OK if they switch seats, so that the pilot flying will be in the seat in which he is most comfortable.

8. It is very important that each approach is started at the scripted time and the aircraft are flying the assigned speed for the approach number. This speed must be maintained to the outer marker unless changed by ATC. You are authorized to tell the pilots to "speed up or slow down" if the speed is not in the ballpark. You are not authorized to help in any other way during the approaches.

9. You will mail the original contracts, expense reports for each pilot and the site coordinator logs once or twice a week to via priority mail. We can't start the pay process until we receive those papers.

   DAILY SCHEDULE

Training:	1100 - 1200 **EDT**
1st Run of Day:	1200 - 1400 **EDT**
2nd Run of Day:	1430 - 1630 **EDT**
3rd Run of Day:	1745 - 1945 **EDT**

Please note that the above times are ***EASTERN DAYLIGHT TIME***. The schedule will probably be modified each day. The times are listed here just as a guide.

PILOT ADMINISTRATION

Pilot List And Schedule

You are given a schedule and a list of the pilots who were assigned to your simulator. We tried to get two captains and one first officer for each day. Since only approaches are being conducted with no emergencies, we feel that the first officers can fly from the left seat in the event we couldn't get the required captains. Each pilot will fly two periods. If there are two captains, one of the captains will relieve the captain for one period and the first officer for one period. It is not necessary for the pilot who does not fly the last period to stay around after he has completed all the necessary paperwork, including the pilot survey on his last day. It is also not necessary for a pilot who has completed the training and doesn't start until the second period, to come in and wait around to fly. You decide how to schedule the pilots.

If someone doesn't show up, try to get a replacement from your pilot list. Contact
) for more names. You should ask the pilots who did show up if they know of anyone who would like to participate. As a last resort if two pilots don't show, you can fly to save the simulator period, but have the scheduled pilot fly all the approaches.

Pilot Code Assignment Sheet

You will assign a separate letter code to each pilot at the beginning of his/her participation in the simulation. There is a sheet on which this information should be entered. The pilot will be referred to by this letter code on the log sheets.

Purchased Labor Agreement, Expense Account Form And Video Release Form (Samples of filled out forms included)

Purchased Labor Agreement: have the pilot fill in the name, address and telephone number at the top, sign the form after "acknowledgment" and insert his social security number and pilot certificate number. You will fill in the dates, number of days pay and the total amount. If, for some reason, only two pilots show up, pay the two pilots 1 1/3 days pay for that day.

1 Day -
1 1/3 Day -

Expense Account Form: The pilot will fill in his name and address on the top and sign and date the form on the bottom. IF A PILOT FLIES ON DAYS OF BOTH WEEKS, HE HAS TO SIGN TWO FORMS, ONE FOR EACH WEEK. Explain that the name and address the pilot fills in will be the one our accounting department uses, so they should be careful that it is readable. You will fill in the numbers on the form as per the enclosed sample.

Video Release Form: Have the pilot print his name, sign and date the form.

You should find a copy machine you can use and make copies of the contract and expense account form for you and for the pilot. You will send the originals back to us by US priority mail every few days so that we can get the paying process started. The copy should be sent back at the end of the simulation with all the other materials. Tell the pilots to call the SRC Pilot Group if they do not get a check within 5 to 6 weeks from the end of the simulation.

This signing in process can take a few minutes. The first day there will be training, so don't waste time. One hour is calling it close so it is important to get started right away.

TRAFFIC SAMPLES, TRAFFIC SAMPLE SCHEDULE, ATIS CARD AND PREPARING CARDS FOR

EACH APPROACH

Three two hour simulator sessions will be flown each day. Each two hour session will be referred to as a "RUN". RUN #1 will be the first two hour period on the first day, RUN #2 the second two hour period, etc., continuing through the simulation for a total of 15 RUNS (5 days with 3 runs each). The last run of the week will be RUN #15. There are four sets of TRAFFIC SAMPLES, 301, 302, 303 and 304. There is a TRAFFIC SAMPLE SCHEDULE which lists for each two hour RUN the TRAFFIC SAMPLE that will be used. The TRAFFIC SAMPLES are the scripts for the two hour simulations and consist of a list of approaches. Each approach is identified by a number which is referred to as an INDEX NUMBER. In front of many of the INDEX NUMBERS is a simulation site and how the approach will be flown (autopilot, hand fly, raw data -GAT only). The individual INDEX NUMBERS that are identified by your simulator will be highlighted and are the ones that your simulator will fly. Cards have been prepared for each INDEX NUMBER for your simulator. Each site will have a clock synchronized with the FAA Technical Center that you will use to place the aircraft into the problem according to the time listed on the TRAFFIC SAMPLE INDEX NUMBER. It is the responsibility of the site coordinator to verify that the cards are in the correct order and are correct. Other information included on the TRAFFIC SAMPLE includes:

AIRCRAFT TYPE - this has no relation to your simulator type and is what will appear on the radar tag. You might be in a MD90 simulator and be assigned a run number that is a B-727. The pilots will always fly the simulator as they normally would even though the aircraft type is different than the simulator. The reason for this is to fool the controllers as to which targets are simulators and which targets are being controlled by a computer operator. The pilots should be aware that the controller might refer, in this case, to your target as a "727" when talking to another aircraft.

IAS - this speed is to be held to the outer marker unless changed by ATC.

CALL SIGN - the call sign will most probably be different than the call sign used by the pilot's company. Have each pilot repeat the call sign out loud before each approach.

INITIAL ALTITUDE - this will be the altitude at simulator release and the altitude of localizer and glide slope intercept.

RUNWAY ASSIGNMENT- this will show the pilot which approach plate to use.

TRANSPONDER CODE - it is VERY IMPORTANT to set prior to each approach. The transponder code is sent over the data line to Atlantic City and identifies the simulator.

HAND FLOWN, AUTOPILOT, RAW DATA - describes how the approach will be flown. All simulators with exception of the General Aviation Trainer (GAT) will only use coupled autopilot and hand flown (using flight director) approaches. Each approach will be assigned one of these methods.

Before you hand the card to the pilots, hold it up in front of the video camera and repeat out loud the index number. This will facilitate identifying the index number when the tapes are reviewed.

Sometimes the FAA Tech Center will call during the simulation and give you a different index number to fly. You will prepare a new card for that index number, give it to the pilots and release the simulator at the new appointed time. A highlighter has been provided for highlighting your index number lines.

ATIS Card: The TRAFFIC SAMPLE will list the ATIS (A, B or C) to be used for each two hour run. The only difference in the ATIS will be the wind. You will have to put the wind into the simulator setup before each run begins. You have been supplied two cards for each ATIS.

VIDEO TAPING INSTRUCTIONS

Each two hour session must be video taped. These video tapes will be used during data analysis, and are a very important part of the entire data collection process. Before each day begins, please be sure that the equipment is working properly. At the end of each day run the tape a few minutes to see if it recorded OK.

Please insure each video tape and each video tape cover is labeled with the following information: Site, Date, Run Number (1,2,3 or 4).

You will be sent enough video tapes for the entire simulation. In case you need more tapes, buy them and put it on your expense account.

The purpose of the video is to capture crew interactions, communications between the pilots, including pilot conversation between approaches, and communications between the cockpit and ATC. We know that we won't be able to see individual instruments, but we will be able to see the pilots' arm and hand movements.

Start the recording at the beginning of each two hour session and stop at the end of the session. To insure that you do not run out of tape in the middle of a two hour run, please record on extended play format (or the slowest speed available) and periodically check how much tape is left. Know what the slowest speed available is and use it. In Atlanta, for example, the slowest speed available will fill up the tape in four hours. In this case, the second two hour period is critical with regard to running out of tape. During the fourth hour the camera should be turned off a minute after the breakout turn is completed or when the sim is stopped in case there was no breakout. Do not forget to hold the index card in front of the camera to identify the run. This is important for the people who are reviewing the 210 hours of tape. If you are told by Atlantic City that the previous approach was a midair (see following section), hold up the TCV shape in front of the camera lens for about five seconds. This will help the viewer find the approach that resulted in the midair collision when the viewer is using the VCR fast forward mode.

You may wait until the end to send all the tapes to SRC or you may send them back at the end of each week. Mail them back in the boxes they arrived in and use the FEDEX prepaid labels in your packet of materials.

SITE COORDINATOR LOG

A new site coordinator log has been developed. The major difference is that the sheet is divided into two sections, a section on the left where every approach will be recorded and a larger section on the right where breakout information or any other abnormal information will be recorded. Any abnormalities noted during the breakout should be recorded. Check the appropriate descending breakout box and circle any abnormalities that occur (simulator problem, communications problem and/or pilot technique problem).

Please fill in the date, run number, traffic sample and wind condition next to the designated spaces at the top of the log. On occasion, the system may fail during a run and be restarted with the same Run Number. If this occurs, for example in Run Number 4, the traffic sample would remain the same, and the Run Number would become 4-2. Always coordinate with the FAA Technical Center at the beginning of each run to verify the Run Number and the start time of your first approach. Please use a new log sheet at the beginning of each two hour run.

The following sections will describe the information required for each column on the Site Coordinator Log:

Index Number - Refers to the index number on the Traffic Sample sheets. It is the sequential approach number.

Call Sign - Refers to the ID number of the aircraft.

Pilot ID - Refers to the letter code assigned to the pilot.

Breakout Questionnaire

After each approach when the pilot was vectored off of the final approach course prior to the D/H, you are to ask the pilots the questions on the Breakout Questionnaire which is located in the plastic envelope on the reverse side of the pre-release checklist. Record the responses in the appropriate columns on the Site Coordinator Log using the appropriate codes. There should be only one set of responses for each approach. Either get a consensus of both pilots or the answers from the pilot flying. Note: DO NOT ACCEPT zeroes or half numbers, just whole numbers.

YOUR MOST IMPORTANT DUTY - Each time there is a mid-air collision (technical criteria violation or "TCV" in simulation study jargon) during one of the approaches, all aspects of the approach are looked at in detail by a number of people from System Resources Corp. There are three video tapes (the cockpit, the radar screen and the controllers) that are scrutinized for each TCV. The logs of the controller observers and the pilot observers are also gone over in detail. We try to determine why the TCV happened and what we can do to prevent it from happening again. After each TCV is scrutinized by SRC personnel, then the TCV data is presented to a large group consisting of people from FAA Headquarters, FAA operations, FAA Technical Center and several government contractors. Your pilot observer log will be viewed and the video of your simulator pilots will be shown to this large audience. The point is that in spite of all the work that you have done, a couple of entries in your simulator log is what is going to be looked at in detail. In the past, the site coordinator never knew when a midair or TCV occurred. We thought that during this simulation we will call you when you have been involved in a TCV. The reason for this is that you might put down more information if you knew that the breakout resulted in a mid-air. However, we do NOT want you to tell the pilots about the TCV. We hope that you put down as much information as possible after each abnormality, but make an extra effort to put down as much as you can recall after a TCV.

LIST OF CONTACTS

A list of flight simulator contacts and coordinators, simulator facility and cab phone numbers, test director primary and backup numbers has been provided. Each simulator site has been assigned a "FAATC Line." You are to use this phone number if you need to reach the FAA Technical Center test director at any time during the simulation. In the event the number assigned to your simulator site is busy, please use the backup number provided for your site. **Each day before the simulation starts you should telephone this number and establish contact with the FAA Technical Center**.

PILOT BRIEFING INFORMATION

A Pilot Briefing pamphlet was sent to each pilot participating. We have included a few extra copies in your materials in case a pilot signed on too late to receive one. We have included a copy of the letter that accompanied the pilot briefing packet so you know what information the pilots were supplied.

TRAINING

The pilots will be trained before their first ride in the simulator. The training will consist of:

SITE	RDU VIDEO	PILOT AWARENESS BULLETIN AND TEST	PROCEDURE BULLETIN AND TEST
GAT	X		
B-727	X	X	
MD90, B-747-400	X	X	X

NOTE: **IF A PILOT HAS PARTICIPATED IN THE OCTOBER '95 OR AUGUST '95 SIMULATION HE IS NOT TO BE RETRAINED**. The training is to emulate annual recurrent training, so is not required until a year has elapsed.

Video

Show the pilots the video, *RDU, Precision Runway Monitor: A Pilot's Approach*. Make sure that the door to the room is shut so that they are not disturbed. The video runs for 12 minutes. We expect that most of the pilots will have viewed the video during the previous simulation. They are not required to see it again, but may view it if they wish. It also might be a good idea for you to review it again.

Pilot Awareness Training Bulletin and Procedures Training Bulletin (if applicable)

After the video, hand out the approach plates, airport information page, Pilot Awareness Bulletin and the Procedures Training Bulletin (if applicable - only for glass cockpits). Do not hand out the tests at this time, just tell them that there will be a test.

The bulletin type training is similar to a pilot going to work and finding a training bulletin in his mail box together with a test. The pilot would read the bulletin, take a short test and hand it in to the chief pilot so that the pilot's training records could reflect that he had received training. You are not an instructor, but you can answer questions if asked. This would be similar to a pilot with a question about one of the training bulletins going into see one of the check pilots to get an answer.

The pilots will grade their own tests. The answers are on the back of the tests. Don't hand out the tests until they read the bulletins and don't tell them they are self-graded until you hand out the tests. We don't need the tests back, but please check to insure that they got the correct answers. We found in one of our previous simulations that a significant number of pilots put down the wrong answer because the question was not covered in the training. Note if more than one pilot gets one of the questions wrong.

PILOT SURVEY

On a pilot's last day, he will fill out a survey. Please stress to him that it is very important to put down all the comments that come to mind. Make sure that the pilot leaving early finishes the survey before he leaves. DON'T

LET HIM LEAVE WITHOUT COMPLETING THE SURVEY. The survey is a very important part of the simulation and we have used the pilots' comments to get procedures changed in the past. If we think that something is needed for safety and it costs money to implement, it is much easier to get approval if we have support from the pilots taking part in the simulation. Many of the procedures in this simulation are a result of pilots' comments in the past and were not achieved easily.

FINAL REPORT

We need a final report from you to help us in this simulation and in future simulations. We would like a summary of your site, what went wrong, what went right, what we should have done, what we did wrong, what you observed as the problems with the close parallel approaches, what you would recommend to make them safer, what we could do to make the simulations more realistic, etc. You will be on the front lines observing first hand, so your comments will be especially pertinent. Some of you gave very detailed reports in August and October and we truly appreciate the time and effort you made. We hope that every site coordinator gives us a detailed report after this simulation. This time you will know that your simulator was involved in a midair collision and can probably give us a better insight as to why. You might be able to give us ideas about better training, better pilot technique, better controller controlling, etc. You might conclude that the runway spacing is too close. You might conclude that all is OK and we should implement this tomorrow. You might be able to pick up something that we didn't observe before (a site coordinator in August picked up a safety item we never knew existed). Any and all of your comments are appreciated. You never can tell us too much.

THE END

At the end of the simulation, pack up all the materials and send them back to . We should already have a signed copy of your Purchased Labor Agreement. Non-SRC employees, if you have expenses, put all your receipts in an envelope along with a detailed accounting of your expenses, SIGN the expense sheets and send it all back to SRC. We will fill in the expense reports for you with your receipt information. All telephone calls must be identified with date, who called, why and from where to where. We will do our best to get your pay as soon as we can. We realize that some of you have put out a considerable amount of money and need to be reimbursed without delay.

Those of us at SRC and our customers at the FAA join to thank you for your participation. You have made a difference in something that might or might not happen in the future of aviation. Not many pilots get that chance. Triple parallel approaches might not happen at 4000' and 5300' runway separation, but if they do or don't you have had an input into the final decision.

18C	T/B727	IP-TIME: 0:04:07

UAL101

HDG: 200°	ALT: 6200'	IAS: 164 kts
LOC: 108.3	TOWER: 127.2	SQUAWK: 326

Autopilot

SITE: NASA SAMPLE: **MPAP 304_Revision 1** INDEX #: **6**

Appendix I

Controller Questionnaires

POST-SIMULATION CONTROLLER QUESTIONNAIRE

April 15-26, 1996

NOTE: All responses provided from the following questionnaire will be reported as an aggregate. Individual responses will not be reported. To ensure complete anonymity, please do not write your name or controller letter on questionnaire. Thank you.

POST-SIMULATION CONTROLLER QUESTIONNAIRE

April 15-26, 1996

Please complete the following questionnaire based upon your experiences throughout the simulation. If you need additional space, use the back of the sheet.

==

1. Triple simultaneous ILS approaches to runways spaced 4000 ft and 5300 feet apart can be safely conducted as simulated. Explain.

1	2	3
Yes	No	Don't Know

____

____

____

____

____

____

==

2. What improvements could be incorporated into the procedures, if any?

____

____

____

____

____

____

____

==

3. Assess the communications workload for the tested procedure. Please explain.

1	2	3	4	5
Low		Moderate		High

==

4. What specific control strategy, if any, did you develop for the simulated approach operation (e.g., inter-controller coordination, display scanning techniques)?

==

5. Assess the adequacy of the briefing information and training aids (e.g., video, training booklet) you were given prior to working the monitor position.

==

6. Please describe any items in the simulation which you believe were not realistic or whose realism could have been improved upon (include any comments about equipment, displays, communication, traffic mix, etc.).

==

8. Additional comments:

==

Thank you for participating in this simulation!

CONTROLLER BLUNDER STATEMENT

April 15-26, 1996

Date: ________________

Controller: ____________　　　　　　　　Blunder ID/Rwy __________________

Runway: ______________　　　　　　　　Evader ID/Rwy __________________

Run Number: ____________

Please answer the following questions accurately and completely.

==

1. From your knowledge of the blunder, provide a narrative summary that may include:

- Location of either/both aircraft relative to the runway threshold
- Location of either/both aircraft relative to its final approach course
- Aircraft type
- Position of aircraft relative to one another
- Volume of traffic

Remarks (continue on back of page if necessary):

____

____

____

____

____

==

2. Once the blunder was detected, (a) what options did you consider and (b) what action(s) did you take? Please describe.

____

____

____

____

3. Identify which of the following alerted you to the occurrence:

(1) Aural alarm (2) Other controller

(3) Data block color change (4) Self-identified

(5) Other ____

(6) Other ____

==

4. Were you distracted by anything that may have influenced the occurrence (presence of visitors, speaker volume, loud talking from others, etc.)? If yes, please describe.

(1) Yes (2) No

____

____

____

____

____

==

5. Identify any of the following which you believe contributed to the incident. Please describe all items identified.

(1) Radar display (2) Radar update rate

(3) Traffic volume (4) Pilot readback

(5) Pilot response time (approx. seconds) ______________________

(6) Other

____

____

____

____

6. Identify any items that may prevent recurrence of a similar situation:

(1) Improve radar display (2) Faster radar update rate

(3) Clearer communication (4) Improved aircrew performance

(5) Other ____

Please describe all items identified. ____

____

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7. Additional comments/narrative.

____

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Appendix J

Flight Simulator Pilot Questionnaires

PILOT BREAK-OUT QUESTIONNAIRE

April 22-26, 1996

1. WAS THE BREAK-OUT INSTRUCTION COMMUNICATED CLEARLY AND CONCISELY? (e.g., rate of speech, clarity, volume, etc.)

   Yes____________ No____________

   If no, state reason:____

   ____

2. HOW WAS THE BREAKOUT INSTRUCTION GIVEN?

   1 - Heading, Altitude (in one transmission)
   2 - Altitude, Heading (in one transmission)
   3 - Heading, Altitude (in two separate transmissions)
   4 - Altitude, Heading (in two separate transmissions)
   5 - Other

   If 5 - Other, please describe:____

   ____

3. WAS A SECOND TRANSMISSION REQUIRED IN ORDER TO RECEIVE A COMPLETE BREAK-OUT INSTRUCTION?

   Yes____________ No____________

   If yes, state reason:____

   ____

4. GIVEN THE CONTROLLER INSTRUCTION, AIRCRAFT CONFIGURATION, AND FLIGHT REGIME, RATE THE DIFFICULTY OF THE BREAK-OUT MANEUVER.

1	2	3	4	5
Not Difficult		Average		Very Difficult

   Please explain:____

   ____

5. WHAT, IF ANY, ADDITIONAL COMMENTS DO YOU HAVE?

   ____

   ____

FLIGHT CREW OPINION SURVEY

April 22 - 26, 1996

DATE_________________________ PILOT CODE____________

TOTAL FLIGHT HOURS__________

HOURS IN TYPE_________________

LAST TIME IN A SIMULATOR (mo/yr)_____________

WHEN YOU WERE TRAINED FOR CLOSE PARALLEL APPROACHES? Aug'95 Oct'95 Apr'96

SITE: AVIA GAT MD90 NASA OK CITY

Please circle the appropriate response for all of the following questions, and provide feedback on the lines provided. If necessary, continue your feedback on the back of the page. If you have any questions, consult your Site Coordinator.

==

1. Based on your experience, how would you choose to fly close parallel approaches?

(1) Coupled Autopilot (2) Handflown (using flt.dir) (3) Handflown (using raw data only)

Comments:

____

____

____

____

2. The Airport Information Page (11-0) increased my awareness of possible traffic in close proximity on the adjacent approach.

1	2	3	4	5
Strongly Disagree		Neutral		Strongly Agree

Comments:

____

____

____

____

3. More crew coordination is required for simultaneous close parallel approaches than for normal ILS approaches.

1	2	3	4	5
Strongly Disagree		Neutral		Strongly Agree

Why?

____

____

4. The Airport Information Page (11-0) increased my awareness of simultaneous close parallel approach procedures.

1	2	3	4	5
Strongly Disagree		Neutral		Strongly Agree

Comments:

____

____

5. The new ATC phraseology ("Traffic Alert") coupled with the word "immediately" encouraged me to respond more quickly to the breakout maneuver than I would have if only the word "immediately" were used.

1	2	3	4	5
Strongly Disagree		Neutral		Strongly Agree

Comments:

____

____

6. The video increased my awareness of simultaneous close parallel approach operations.

1	2	3	4	5
Strongly Disagree		Neutral		Strongly Agree

Comments:

____

____

7. The training bulletins (Pilot Awareness and Procedure-if applicable) increased my understanding of what is expected of me during simultaneous close parallel approaches.

1	2	3	4	5
Strongly Disagree		Neutral		Strongly Agree

Comments:

8. What additional items would you like to see on the close parallel simultaneous approach plates?

9. What additional information would you like to see on the Airport Information Page (11-0)?

10. The training bulletins helped me to execute the ATC-directed breakouts.

1	2	3	4	5
Strongly Disagree		Neutral		Strongly Agree

Comments:

11. What additional information or training would you like to have for simultaneous close parallel approach procedures?

12. Based on your experience in the airplane you fly, what percentage of ILS approaches are flown on autopilot to Category I minima during IMC in normal line operations:

(a) B-747-400 and MD90 pilots answer here:

(1) 0 - 25 (2) 26 - 50 (3) 51 - 75 (4) 76 - 100 (5) Don't Know

(b) B-727 pilots answer here:

(1) 0 - 25 (2) 26 - 50 (3) 51 - 75 (4) 76 - 100 (5) Don't Know

Comments:

___

___

___

ANSWER THE FOLLOWING QUESTIONS ONLY IF YOU HAVE **TCAS** EXPERIENCE

13. Assume that you are flying the simultaneous close parallel approach with the TCAS in the R/A mode. Air traffic breaks you out from the ILS with a turn and climb, you begin the breakout maneuver and the TCAS gives a descent command, what would you do? (Circle your answer)

1. Continue the turn and climb, and ignore the TCAS.
2. Continue the turn, but begin a descent as directed by the TCAS R/A.
3. Stop the turn and start a descent.

14. If you knew that during an ATC directed breakout from an ILS, 50% of the time the TCAS R/A command would be opposite from the controller climb or descent command, what TCAS mode would YOU (not your company) choose to set before the approach? (Circle your answer)

1. R/A Mode
2. T/A Mode

15. Please list the importance of each of the following items to a pilot flying a close parallel simultaneous approach. The same rating can be used for more than one category.

1=Not Important, 10=Very Important

Item	Rating 1 to 10
Video	
Airport Information Page (11-0)	
Separate Approach Plate for Close Parallel Simultaneous Approaches	
Notes in boxes on Approach Plate	
Pilot Awareness Bulletin	
Breakout Procedure Bulletin (MD - 90 / B - 747 - 400 ONLY)	
The use of words "Traffic Alert" in the breakout instruction	

16. Write down the points that you think are important for the pilot to know about simultaneous close parallel approaches. Use single words or short phrases in your list.

17. Additional comments on the simulation or on the tested procedure.